THE

FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL

VOL. 59 Thursday, October 13, 1938 No. 1156

PUBLISHED WEEKLY

Subscription Terms : 17s. 6d. per annum.
Foreign and Colonial : 20s. per annum.
All Subscriptions are payable in advance.

All Communications to be addressed to the Editor, the Advertisement Manager, or the Publisher of

THE FOUNDRY TRADE JOURNAL
49, WELLINGTON STREET, LONDON, W.C.2

Telegraphic Address : "Zacatecas, Rand, London."
Telephone : Temple Bar 3951 (5 lines).

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF

The Institute of British Foundrymen

The Institute of Vitreous Enamellers

The Welsh Engineers' and Founders' Association

and

The Foundry Trades' Equipment and Supplies Association

Institute of British Foundrymen

PRESIDENT : 1938-39

J. Hepworth, J.P., M.P., "Ingle Nook," Bolton Road, Bradford.

LIST OF SECRETARIES—

General Secretary : T. Makemson, Saint John Street Chambers, Deansgate, Manchester, 3. London Office : 49, Wellington Street, London, W.C.2.

Birmingham, Coventry and West Midlands : A. A. Timmins, A.I.C., 21-23, St. Paul's Square, Birmingham, 3.

East Midlands : B. Gale, "Parkdale," Boulton Lane, Alvaston, Derby.

Lancashire : J. E. Cooke, 7, Warren Drive, Swinton, Manchester.

London : G. W. Doglish, Stewarts & Lloyds, Limited, Winchester House, Old Broad Street, E.C.2

Middlesbrough : G. P. Kirk, North-Eastern Iron Refining Company, Limited, Stillington, Stockton-on-Tees.

Newcastle-upon-Tyne : C. Lashly, Sir W. G. Armstrong, Whitworth & Company (Ironfounders), Limited, Close Works, Gateshead-on-Tyne.

Scottish : J. Bell, 60, St. Enoch Square, Glasgow.

Sheffield : T. R. Walker, M.A., "The Priory," Oughtibridge, near Sheffield.

Wales and Monmouth : J. J. McClelland, 12, Clifton Place, Newport, Mon.

West Riding of Yorkshire : S. W. Wise, 110, Pullan Avenue, Ecclesshill, Bradford.

South Africa : F. C. Williams, Magor House (Fifth Floor), 74, Fox Street, Johannesburg.

Bristol : A. Hares, Park Crescent, 648, Stapleton Road, Bristol, 5.

Burnley : W. Haworth, 37, Westbourne Avenue, Burnley, Lancs.

East Anglian : J. L. Francis, 12, Glenhurst Avenue, Colchester Road, Ipswich.

Falkirk : T. R. Goodwin, "Viewfield," Falkirk Road, Bonnybridge, Scotland.

Lincoln : E. R. Walter, M.Sc., The Technical College, Lincoln.

The Institute of Vitreous Enamellers

President : Sir Harold Hartley, F.R.S., Euston Station, London, W.C.1.

Chairman : W. H. Whittle, W. H. Whittle, Limited, Eccles, near Manchester.

Hon. Secretary : Miss E. Christine Elliot, 49, Wellington Street, Strand, London, W.C.2.

Foundry Trades' Equipment and Supplies Association

President : A. C. Turner, Russell House, Adelphi, London, W.C.2.

Secretary : K. W. Bridges, Grand Buildings, Trafalgar Square, London, W.C.2.

Welsh Engineers' and Founders' Association

President : W. E. Clement, Morfa Foundry, New Dock, Llanelly.

Secretary : J. D. D. Davis, 9, Royal Metal Exchange, Swansea.

BRITISH CAST IRON RESEARCH ASSOCIATION

The Registered Office and Laboratories of the B.C.I.R.A. are :—
21-23, ST. PAUL'S SQUARE, BIRMINGHAM
Telephone : Colmore 4274-4275 Telegrams : CIRA

The B.C.I.R.A. Scottish Laboratories are :—
Foundry Technical Institute, Meek's Road, Falkirk
Telephone : 332

Contents

	PAGE
The Branch Programmes	265
Holiday Savings	265
Activated Carbon Works	266
Catalogues Received	266, 268
Fineness of Powdered Materials	266
Institute of Metals	265
Publication Received	266
London Foundrymen Open New Session	267
Better Business Methods Needed	268
Desulphurising Pig-Iron by Ladle Treatment with Soda Ash	269
Selection of Refractories	272
Broken Hill Developments	273
Company Meeting	273
Some Fundamental Properties of Moulding Sands	274
Rust Preventive for Cupolas	276
Imported Blast-Furnace Machinery	276
West Yorkshire Foundrymen Make Presentation to Mr. J. Hepworth	278
The Iron and Steel Institute	278
The Week's News in Brief	280
Trade Talk	280
Personal	280
Obituary	280
Zinc Supplies and Prices	280
Forthcoming Events	280
Raw Material Markets	282

The Branch Programmes

Recipients of the Programme of Branches for 1938-1939, issued by the Institute of British Foundrymen, should realise that there is a minimum of collaboration between the various committees charged with the creation of a series of lectures. This is a particularly desirable aspect, for it tends towards the arrangement of programmes best suited to local needs, and conduces to the discovery of new lecturers. The diversity of subjects scheduled is outstanding, and is due to this effort to cater for district requirements. This does a magnificent service to industry because, whilst areas have certain concentrations of similar activities amongst the local foundries, yet well separated from these areas are works engaged in a similar line. For instance, a comparison between London and Sheffield reveals that the former is particularly rich in non-ferrous foundries, but possesses only a few foundries manufacturing steel castings, whilst the reverse conditions obtain in Sheffield. This lack of co-operation could be opposed on such grounds that the programme for the present session includes no Paper directly concerned with malleable, *per se*. Yet deeper consideration shows that the requirements of this branch of the industry have not been entirely neglected, as there is a plethora of work on sand control and major questions of shop organisation.

There are several lectures which break new ground. For instance, Middlesbrough is to have a lecture by Mr. H. Foster on "Statuary Castings"—a subject last dealt with about a decade ago by Mr. J. Longden. Sheffield's contribution to novelty is a Paper by Dr. G. H. Froggatt, who has both medical and dental qualifications. Dr. Froggatt is to deal with "Foundry Work in Dentistry." Finally, amongst Papers of a novel character, is one which is to be given by Dr. W. D. Jones to a Joint Meeting of the London and Sheffield Branches, which will reveal for the first time the extraordinary properties given by sintered compresses of powdered cast iron. Another novel title is "What We Do Not Know about Cast Iron," by Mr. J. E. Hurst, to which the London Branch will listen. The severely practical side is more prominent this year than usual. Scotland, the North and Midlands have arranged for quite a number of Papers dealing with the actual construction of moulds.

Viewed from no matter what angle—theory, practice, organisation or novelty—the programme promises to be amongst the most interesting of recent times, and will be happily free from the not unwarranted adverse criticisms which have been levelled against a kindred society.

There are possibly fewer works visits on the programme than is usual, but this is due no doubt to factors beyond the control of the various committees, as in many cases the Government departments have placed a ban on the reception of visitors at establishments where rearmament work is in progress.

Holiday Savings

As a logical sequence to the "holidays with pay" movement, there has been a definite and increasing interest in savings clubs as organised by industrial establishments. There are several snags connected with the operation of such clubs, and the Industrial Welfare Society (of 14, Hobart Place, Westminster, London, S.W.1) has done well to publish a sixpenny brochure explaining ways and means of overcoming them. There is nothing very novel about the idea of a holiday savings club, for they have been in vogue in Lancashire and Yorkshire for many decades, but now that a number of firms grant "holidays with pay," added importance is lent to their conduct. Regarding holiday catering as a business, it must be obvious to those with but a limited knowledge of cost accounting how difficult it is to make a profit—without gross overcharging—when the establishment is operated on a 25 per cent. capacity load. This factor must be kept in the forefront of all organisers of "works holiday saving schemes," so that withdrawals can be made at a time when the operative takes his holiday. Where it is essential for the whole works to be shut down for a period, then arrangements should be come to with other works in the district in kindred industries to choose a different period. Only by this means can a satisfactory spread-over holiday period be instituted, with corresponding lower costs.

There is some space in this pamphlet devoted to the actual organisation of holidays by the firms. Surely this is carrying the social side of industrial enterprises too far, for there is not, and cannot be, a common denominator for holiday aspirations. Holidays are a time when men and women want to free themselves of the works atmosphere, make new contacts, and possibly find a little romance in life. It seems that some firms have established holiday camps, whilst others possess a large house to be used as a holiday home. We would prefer the closing up of the former and the use of the latter as a convalescent home.

The major value of this pamphlet is the setting out of rules formulated by some of the best-known industrial houses for the conduct of their savings clubs. From amongst these it is easy to create regulations suited to individual cases.

Activated Carbon Works

AN IMPORTANT INDUSTRY

In the scheme of National Defence, few products are of more vital importance than activated carbon, which is, of course, used for gas masks. The manufacture of this product is not a recent introduction into this country; it was being produced during the war period by Sutcliffe, Speakman & Company, Limited, of Leigh, Lancs, and, indeed, the original retort is still in active service. Present demands are, however, on a much more extensive scale, and it is obviously essential that those demands should be met in the shortest possible time.

When the present need arose it was only natural that the pioneers of the process in this country should be called upon to meet it. Intensive production was only possible in a factory specially equipped for the duty, and the building of such a factory would have taken valuable time. Messrs. Sutcliffe, Speakman were therefore fortunate in being able to purchase adjoining buildings which lent themselves to rapid adaptation.

Manufacture of activated carbon from the raw to the finished product involves a number of processes, and, in a factory of normal design, transport of the material between the several processes would necessitate a somewhat extensive conveying and elevating system; the height of the present building, however, enables the work to be done by gravity. There is only one elevation, that of the raw material from the ground floor to the top floor, and this is done by a hoist, the material then passing downward through the various processes to reach the basement as a finished product packed ready for despatch.

The works were recently visited by our representative and, whilst, for obvious reasons, we do not propose to enter into any details concerning the process of manufacture, a few notes on the lay-out will no doubt be interesting, and will convey some idea of the magnitude of the undertaking which, in point of fact, is the largest in the world devoted to the manufacture of activated carbon and is capable of meeting the whole demands of the country.

There are 16 retorts, exclusive of the one originally built, which is on an adjacent site. These retorts are charged from the top floor. Here, also, are the motor-driven recirculators. The atmosphere is maintained in a pure condition by the circulation of fresh air which is drawn in through an overhead pipe system. The floor below is given over to the retorts proper and the control room, which is equipped with a complete range of instruments by the Cambridge Instrument Company, Limited. The retorts are discharged on the floor below to the grading machines, which deliver the product to the assembly floor, where the material again passes through a special form of grading plant and thence to the blending pans which deliver to the screening plant on the floor below. After screening, the material is delivered to the final blending plant of the drum type, which takes a charge of 10 tons. From this blender the material is delivered as a finished product.

The necessary steam is raised in three Lancashire boilers. The requirements are of a very exacting character, and the whole of the operations are controlled from the laboratories, where also all finished product is subject to the most rigid tests. Coco-nut shell carbon usually constitutes the raw material, and at the present time this is being employed exclusively, because it lends itself most readily to rapid production. At the same time it is gratifying to note that such material is not essential for the production of activated carbon, Sutcliffe, Speakman having developed a process whereby all varieties can be produced from coal.

At the time of our representative's visit, work was proceeding with the erection of the necessary plant for manufacturing from coal.

Catalogues Received

Foundry Plant and Supplies. The receipt of a 48-page catalogue and about a dozen leaflets and brochures from the Fordath Engineering Company, Limited, Hamblet Works, West Bromwich, serves to stress the advantages to be derived from the use of a loose-leaf system. The actual catalogue, which is a splendid production, very adequately covers the subjects of core oils, blackings, "Rotoil" core sand mixers, laboratory service, multiple rotary core-making machines and sand driers. The various pamphlets which accompanied the main catalogue give detailed descriptions, usually illustrated, of a "cut-off" machine for cores; the "Dual" sand mill; the light roller mill; the Craven-Longden mould and core drier; new types of core compounds, and Fordavol, a new material for eliminating troubles arising from scabbed moulds and mould washes. Additionally, there are several instruction sheets for the starting up and maintenance of the various types of plant the firm manufactures. A very high standard of publicity has been achieved throughout, and it carries with it a conviction of service to the customer. Very rightly it is stressed that this costs money—a fact overlooked by some concerns. A unique feature of the catalogue is the series of splendid illustrations of cores made from "Glyso." The range includes perhaps the largest core ever made in oil sand, and many examples of extremely complicated design. These well illustrate a modern tendency of building up mould assemblies entirely from cores. The catalogue and the various pamphlets are available to our readers on application to the works at West Bromwich or the various branch establishments in Australia, Holland, France and India.

Pulverised Fuel Firing. A leaflet received from the British Rema Manufacturing Company, Limited, of Halifax, sets out in clear language the benefits to be had from pulverised-fuel firing and the special services this firm can give. A second one details more especially the actual pulverising mills.

Fineness of Powdered Materials

In a Paper presented before the Institution of Mechanical Engineers on the "Measurement of the Fineness of Powdered Materials," DR. H. HEYWOOD, who is Senior Research Officer, British Coal Utilisation Research Association, described in detail the methods of analysis at present available for measuring the fineness of powdered materials used in engineering and industrial processes. Definitions of particle size and shape were discussed, and examples given of the size-distribution curves for typical industrial powders. Sieving or screening was used for the size grading of the comparatively coarse particles, and processes involving motion in a fluid for particles smaller than the limit of sieving. The theory of sieving and the relationship between particle size and sieve aperture were discussed, and the equivalent sizes of round, square, and slotted apertures measured. The motion of irregularly shaped particles in a fluid was briefly described, and a method was given for calculating the falling velocity of such particles when the fluid flow round the particles is turbulent. The procedures used for the fineness analysis of sub-sieve particles are: Elutriation by means of air or water, sedimentation, hydrometer readings, and the obscuring of a beam of light by dilute suspensions of the particles.

I.V.E. Trip to U.S.A.

We reported last week that the official visit of the Institute of Vitreous Enamellers to the U.S.A. this month had been cancelled. We understand, however, that when the international situation became clarified the decision was reversed, and a party of members sailed, according to original plans, on October 1. It is not certain whether the full itinerary will be followed.

Institute of Metals

The Institute of Metals has issued the annual programme of its meetings and those of the several local sections for the winter session. Of the four general meetings of the Institute announced, the first is the annual business meeting, to be held in London on March 8 and 9. The annual dinner will be given on March 8 at Grosvenor House, Park Lane, and will be followed by a dance.

The May Lecture—the twenty-ninth of the series—has been arranged to be delivered in London on May 10. In September the thirtieth autumn meeting will be held in Glasgow, should it not be possible for the postponed American meeting to take place next year in New York.

The programmes of the six local sections of the Institute and of the associated Manchester Metallurgical Society include more than 40 lectures on metallurgical subjects, as well as works visits, a film display, a supper-dance, and joint meetings with other societies. The Papers included in the programme cover such subjects as "Modern Non-Ferrous Foundry Practice," "Tin—Its Extraction and Uses," "New Methods of Working Metals," "Light Alloys for Aircraft," "Defects in Non-Ferrous Ingots," "Aluminium Alloys in the Foundry," "Die-Casting," "The Mechanism of Corrosion," "Metals of High Purity," and "Copper Alloys and Their Adaption to Modern Engineering Requirements."

Copies of the programme and invitations to the meetings can be obtained on application to the Secretary, Mr. G. Shaw Scott, 4, Grosvenor Gardens, London, S.W.1.

Publication Received

Kelly's Directory of the Engineering, Hardware, Metal and Motor Trades. (23rd Edition). Published by Kelly's Directories, Limited, 186, Strand, London, W.C.2. Price 50s., post free.

This Directory embraces England, Scotland and Wales, and contains the names and addresses of those engaged in the various trades indicated by its title, both the manufacturing and selling branches being adequately dealt with. The following headings (selected from a total of over 2,000) give an indication of the wide scope of the information supplied:—Aerial ropeway contractors; boiler makers; colliery proprietors; cycle agents and dealers; electrical instrument manufacturers; electric lighting, power and traction undertakings; gasworks; ironmongers (both wholesale and retail); motor-car manufacturers; motor engineers and garages; pump makers; safety-razor makers; railway plant contractors; and steeplejacks.

The book comprises the following information: (1) The names for each county, arranged alphabetically under the towns and villages; (2) an alphabetical classification of trades for the London Postal District, with the names arranged under each trade heading in alphabetical order; (3) a similar classification of trades for the rest of England, Scotland and Wales. There are also the following special sections:—(1) An alphabetical list of the names of some 10,000 branded articles and specialities used in the engineering and allied trades, together with the names and addresses of the manufacturers; (2) an alphabetical list of the names (with addresses) of the manufacturers of iron and steel sections, plates, sheets, etc., arranged under their various classifications, together with the sizes, etc., made by each; (3) a list of various brands which appear on iron and steel work, together with the makers' names and addresses.

The task of revision and correction for this new edition has been as arduous as for any of its predecessors, and preserves the fine record for accuracy which this well-known firm of directory publishers enjoys.

London Foundrymen Open New Session

INNOVATIONS IN WINTER PROGRAMME

The members of the London Branch of the Institute of British Foundrymen met at the Charing Cross Hotel on Wednesday, October 5, to commence the work of the 1938-39 session. They were welcomed by Dr. A. B. Everest (the retiring Branch-President) and Mr. C. C. Booth, J.P. (the incoming Branch-President). A particular welcome was extended to Mr. Spring, an overseas visitor from Australia.

Apologies for absence were received from Mr. Barrington Hooper (Branch Vice-President) and Mr. V. C. Faulkner (Past President of the Institute). The minutes of the preceding meeting were taken as read and were confirmed and signed.

Retiring President's Tribute

DR. EVEREST, who presided during the early part of the meeting, said that he could not formally vacate his office without expressing his very great appreciation and thanks to the Council and all members of the Branch whose help had made the past year a success. His year of office as Branch-President had indeed been a happy one. The affairs of the Institute, he said, called for a tremendous amount of voluntary work from its members, and the activities of its various Committees provided a very fine example of team work. All that work was honorary, and the way in which it had been done was extremely gratifying. In particular, he thanked Mr. R. Causebrook, who had served as Branch-Secretary during the past year and who had carried out a tremendous amount of work for the Branch. The members regretted that pressure of other work had made it necessary for him to resign. He was succeeded by Mr. G. W. Daglish.

In welcoming Mr. Booth, the new President of the Branch, Dr. Everest said that he was a man of many parts, but essentially he was a practical foundryman with a very wide experience. The range of products which his firm turned out included piano frames, castings of all types for the electrical industry, and one particular casting his firm had made recently was in the nature of a stand for the Archbishop's crozier at Canterbury Cathedral. From the technical and all other points of view, Mr. Booth was well qualified to lead the Branch throughout the session. He was also a keen yachtsman, and he was a Justice of the Peace. Dr. Everest expressed on behalf of himself and members generally the hope that Mr. Booth's year of office would prove another successful venture for him, and their confidence in the future of the Branch under his guidance.

MR. BOOTH formally occupied the chair, and expressed his appreciation of the remarks made by Dr. Everest, which he hoped would be fully justified.

PRESIDENTIAL ADDRESS

In the course of his address to the Branch, MR. BOOTH said he considered the members had good reason to feel justly proud that the Institute was a healthy and growing organisation, as at the present time the modern tendency is to develop rather more collectively than individually. Further, the value of co-operation could not be stressed too emphatically, not only from the point of view of the benefit to individual members of the foundry industry, but also in helping them to meet the formidable competition of other industries, which were encroaching in their markets with substitutes for cast products.

Members were often asked what was the advantage of joining the Institute of British Foundrymen. Mr. Booth thought it would be clearly in the minds of all, by reason of the recent trend of international affairs, that there was practically no limit to what could be done by friendly discussion. Most of the leading industries in the country had their institutes, associations or federations. Many of the traders had selling organisations in connection with which considerable sums of money were expended, but they spent far less on such institutes as the I.B.F., which, in the speaker's opinion, were far more useful and helpful in enabling one to make better products, and thereby not only hold present markets, but to extend them.

The Institute's members were anxious to educate the workers in the industry, and it was hoped later to publish more of the Papers which were read at the meetings, as well as to publish other information which should prove useful. If the junior members would take sufficient interest, the Institute should be able to urge that the County Councils do more in the provision of technical education, which had, Mr. Booth suggested, been rather neglected.

Referring to the Branch programme, Mr. Booth said that this year the Council had endeavoured to introduce several innovations which they hoped would be both interesting and advantageous. The annual dinner, which for many years had been held at the Charing Cross Hotel, would this year be held at the Criterion Restaurant; this would extend the accommodation considerably. It was proposed to invite ladies to attend, and in addition to the usual concert there would be dancing. The Branch Council was hopeful that the occasion would be a definite improvement on previous years, although the cost of tickets would remain the same.

The Branch was also holding in London a joint meeting with the Sheffield Branch, and another meeting would be held at the Sir John Cass Technical Institute, in connection with which Mr. G. Patchin (the Principal) was giving every support. As this was the chief school of metallurgy in London, the evening should be very interesting and profitable. There was also to be a debate on "Castings *versus* Welded Structures." In this debate no one speaker would be allowed more than ten minutes, by which means it was hoped to encourage as many members as possible, especially the younger men, to take part in the discussion.

Mr. Booth concluded his remarks by reminding the members of the meeting which was to be held in Manchester on October 15 for the purpose of considering the proposed alterations to the Rules of the Institute.

Vote of Thanks to the Branch-President

MR. H. W. LOCKWOOD, proposing a vote of thanks to Mr. Booth for his address, referred to the new developments for the coming year which had been indicated in the address. He said that those who were concerned with the inner workings of the Branch knew that the whole of those developments were due entirely to Mr. Booth. As the result of them, the coming session would differ from previous sessions, and a further step would be taken in the progress of the Branch; it would become even bigger and more important than it had been in the past.

MR. C. H. KAIN (Past-Branch-President), seconding the vote of thanks, said that all the members welcomed Mr. Booth as President, for they respected him both as an individual and in his capacity as a foundry proprietor. The foundry proprietors who became Presidents of the Branch rather set the tone to which the executives would have to work in the coming years. Mr. Booth had already set a very high level, which augured well for the continued success of the Branch.

The vote of thanks was carried with acclamation.

The BRANCH-PRESIDENT briefly responded. He again drew particular attention to the debate which was to be organised on the subject of castings *versus* welded structures, and which he hoped would be on rather different lines from ordinary debates.

Vote of Thanks to Retiring President

MR. V. DELPORT (Past-President of the Branch) proposed a hearty vote of thanks to Dr. Everest for his fine work as President of the Branch during the past year. They all knew Dr. Everest, he said, as a man with a very considerable knowledge of the basic metals with which they had to deal, and as one with experience of conducting meetings, a fact which they had had an opportunity of appreciating during the past year. Under his presidency the work of the Branch had been of great interest, not only in respect of the Papers that had been presented and discussed, but also from other points of view. One of the events of the past session to which Mr. Delport referred particularly was the interesting visit to the foundries of the West Country. The members were very grateful to Dr. Everest, he said, for his efforts and for the amount of thought he had given to the work of the London Branch.

MR. A. TURNER, seconding, endorsed Mr. Delport's remarks and said the Branch had enjoyed a successful year under Dr. Everest's presidency.

The vote of thanks was carried with enthusiasm.

DR. EVEREST, in a brief response, repeated that his year of office had been very happy and added that the basis of that happiness was the support and co-operation he had received from all members of the Council and of the Branch. He felt sure the same loyal co-operation would be given to Mr. Booth in the coming year, during which a great deal of extra work would have to be done, in view of the fact that the International Foundry Congress would be held in London in 1939.

The Institute's Rules

Following the remarks made by the Branch-President concerning the meeting to be held in Manchester, MR. C. H. KAIN proposed the following resolution which, if carried, should be sent to the General Secretary of the Institute:—"That this meeting of the London Branch of the Institute of British Foundrymen approves the new Bye-Laws as proposed by the Organisation Committee to be submitted to the General Meeting on October 15."

MR. BROWN seconded the resolution, which was carried unanimously.

Desulphurising Pig-Iron by Ladle Treatment with Soda Ash

(*Concluded from page* 271.)

Caustic soda, because of its lower melting point and greater activity as compared to soda ash, makes for more violent boiling action or more rapid contact between metal and slag. Boiling may be prolonged in some cases by additions of soda ash and other carbonates to the caustic. With fused soda ash, boiling action is prolonged by gradual melting of the 2-lb. briquettes.

Conclusion

It is hoped that this outline of the reactions applying in desulphurising molten iron with the alkalis has served to illustrate: (1) the importance of selecting the reagent in relation to the character of the metal to be treated, and the extent of desulphurising required; (2) the necessity of correct equipment design and layout for carrying out the process in an efficient manner; (3) the importance of carrying out the operations strictly in accordance with a fixed schedule, found by experience to produce efficient and consistent results.

D

Better Business Methods Needed

Mr. R. SPRIGGS' VIEWS AT EAST MIDLANDS MEETING

The East Midlands Branch of the Institute of British Foundrymen opened its new session at a joint meeting with the Lincoln Section, held at the University College, Nottingham, on September 24. MR. W. T. EVANS, the retiring Branch-President, in opening the meeting, thanked the members for the assistance they had accorded him last session, and then called upon Mr. R. Spriggs, President of the East Midlands Branch, to present his inaugural address.

PRESIDENTIAL ADDRESS

In the course of his address MR. SPRIGGS said that he would deal with two subjects—the foundry industry and the Institute. His work for the foundry, which was chiefly concerned with mechanisation, took him into many different works, and brought him into contact with a great many executives.

These many contacts created various impressions, and the most arresting of the recent ones was the increasing liveliness and enterprise of the industry as a whole. Although it was amongst the most ancient, there never was a time when it was more alive, fresher, and more modern and progressive in its outlook or when it offered better prospects for the enterprising young man. The personnel was already vastly different from what it used to be. A higher standard of ability and knowledge was necessary, and there was a much greater call for the youngster of more than average capacity.

Much less was heard about the inroads made by fabricated steel work and other kinds of competition. On the contrary, the personnel was brimful of enthusiasm about its new products, new methods and special alloys; some of the latter were replacing hardened steel plate work, and this had all come about by the initiative, pluck and brains within the foundry industry.

Poor Business Methods Condemned

Research work was being vigorously carried out in all directions, and probably the advance in research surpassed the progress made on the business side. On the research side he referred to metallurgical work, new alloys including high-duty irons, sand control and the like, whilst on the business side reference was made to the general administration, buying, selling, etc. Here there was room for improvement. The sloppiness of modern business methods in all branches was, he considered, rather appalling. In correspondence the omission of necessary references was almost the rule, and the quality of the work was bad, marked by redundancy, verbosity, bad phraseology and signatures one could not read. Sales methods were often poor. How often did the salesman play into the hands of the buyer! The man who telephoned and asked for the order which he knew was to be placed invited the buyer to say he would have to pass him, he had to buy as cheaply as possible, and he had a lower offer. Such a tactic often cost the seller many pounds, and was bad salesmanship. There was a strong line to take in selling, just as in buying. Some jobs were so reduced in price and pressing in delivery that they were useless, and it was sometimes good business to refuse a job. Anyone could sell at a loss, but it took a good salesman to sell at a profit.

The Institute might well start a research department to investigate selling methods. It might in time become as important as the British Cast Iron Research Association!

Staff Tuition Important

On the business side tuition and development of staff must rank highly. Here, human nature was apparent. A man might be a very clever foundryman, but a complete failure at imparting knowledge and training youth. Industry was apt to neglect this aspect or ignore it if the man was otherwise good.

This question of staff tuition was a most important one. It was no uncommon thing to find that whilst in certain sections the boys appeared to be well employed and pushed on in various parts of the work, in other sections the people in control did not appear to be able to use boys at all. Obviously, every foreman could not be expected to possess the gifts of a schoolmaster, but it was stressed that the ability to teach youngsters should receive more attention from the management when the choice of section leaders, foremen, etc., was being considered.

On the business side, there was also the question of manufacturing methods, mechanisation and repetition methods. So far as mechanisation was concerned, there were still too many men who spent their time finding reasons why they could not mechanise. What was wanted was study to ascertain how it could be done. It always meant alteration of method and reorganisation. Surely it was more profitable to explore the possibilities than the impossibilities, and it was a matter to which no foundry executive could afford to close his mind, because mechanisation was too much of an accomplished fact and handling costs under old systems were too serious. There was another mental attitude that was still fairly common, and that was to regard conveyors as something to be bought willy-nilly at so much a ton, the purchase of which would automatically mechanise production without altering any of the previous methods of moulding or pouring, or anything else. Such an attitude quite failed to realise that continuous moulding and casting could only be achieved by very long and careful study and reorganisation of work to suit continuous methods. This attitude was always surprising, so much so that, being apprised of it, a manager of a successful mechanised foundry remarked: "Surely there are not people like that to-day." There ought not to be, but there were!

A feature of mechanisation was that it must carry some benefits to the operatives; in other words, there must be something concrete in it for the moulder, and for the pourer, as well as for the executive. If a moulder had been habitually turning out 100 moulds on the floor every day, one could not expect him to be content to turn out 400 a day on the mechanised plant and receive nothing extra in his packet at the week-end. It was only human for him to expect to get at any rate a little of the benefit from the extra output.

The Branch-President then dealt with the proposed reorganisation of the Institute to be considered at the postponed annual general meeting next Saturday.

Vote of Thanks

MR. EVANS thought the Presidential Address had covered the essential things of the Institute, and he was in agreement with most of Mr. Spriggs' remarks. Whoever installs a mechanised system must be sure it was going to pay, as, of course, it was expensive. Mechanisation had to come, but with it there had also to come sufficient orders. The foundry was becoming a better work place, through mechanisation, and an aim of the Institute was to ensure hygienic conditions and cleanliness. A buyer very often received the idea that if a foundry were mechanised he would be able to secure a first-class job at a very cheap price, yet the foundry industry must get a reasonable price for a job.

Mr. Evans then proposed that a vote of thanks be accorded to Mr. Spriggs for giving his address, and hoped the new President would enjoy his year of office, and that all the members would give him a maximum of support.

After MR. G. L. HARBACH, President of the Lincoln Section, had seconded the vote of thanks, which was heartily accorded, MR. SPRIGGS again stressed the opportunities available in the foundry industry for the young entrant.

The President was then called upon to present the prize offered by Mr. Evans for the best contributions to the discussions during the previous session. This was awarded to Mr. R. H. Buckland.

MR. BUCKLAND said it was a surprise to receive the prize. He had certainly taken part in the discussions last session, but to his mind only to a small extent, and he hoped the other members would now enter into the discussions more so than they had done previously.

MR. SPRIGGS then asked Mr. P. A. Russell, B.Sc., to present the Report of the Cast Iron Sub-Committee upon the Properties of Grey Cast Iron.

Catalogues Received

Spectrographic Outfits. We have received from Adam Hilger, Limited, 98, Kings Road, Camden Road, London, N.W.1, the ninth edition of a catalogue bearing this title. Generally speaking, the foundry industry has not yet included the spectroscope as either an instrument for research or routine control, though we have reproduced an article (see the JOURNAL for August 12, 1937) describing the results obtained by an American foundry. This apparatus is regularly used by the National Physical Laboratory and the British Non-Ferrous Metals Research Association in their metallurgical researches. Its usefulness is unquestionable and undoubtedly it will find its way gradually into the field of cast metals research. The book runs to 64 pages, is well illustrated and is available to our readers on request.

Patternmaking. Pattern Makers Engineering Company, Limited, Shrewsbury Road, Willesden, London, N.W.10, have prepared a 14-page catalogue which details the service they have built up for the furnishing of patterns, castings and general engineering work. The catalogue reveals that they make patterns in wood and all types of metal for use as master patterns. Some interesting technical data are included, and a table showing how to calculate the weight of a casting from patterns of various types of timber will be welcomed by many. Lists are given of the various authorities and firms, from the Admiralty downwards, to which they have supplied patterns.

One-Line Lubrication System. A twelve-page well-illustrated brochure has been prepared by Tecalemit, Limited, of Great West Road, Brentford, Middlesex, with the object of popularising centralised, controlled lubrication. In a continuous casting foundry there must be dozens, if not hundreds, of points requiring lubrication, as, for instance, along the pouring conveyor, and yet as far as we have seen this work is still performed manually. Whether such a system as is described in this brochure is applicable is a matter for the engineering side, as according to this fraternity the foundryman is somewhat negligent.

Thermometers. The Cambridge Scientific Instrument Company, Limited, of 13, Grosvenor Place, London, S.W.1, have issued a new folder dealing with mercury-type thermometers reading from −40 to 700 deg. C. Although they have been manufacturing these for thirty years, the recent introduction of new types of heat-resisting alloys has allowed of a complete redesigning of the instruments with consequent improvements.

Desulphurising Pig-Iron by Ladle Treatment with Soda Ash*

NON-TECHNICAL DISCUSSION OF THE REACTIONS OF ALKALI SLAGS

By GEORGE S. EVANS

Certain American operators believe that desulphurising in the ladle offers a means of increasing blast-furnace and open-hearth yields with the possibility of improvements in quality of the steel. In fact, several producers have experimented with practically all of the known desulphurising agents, including both standard grades of the alkalis and special preparations that have been offered from time to time during the past several years. Some of these are regularly being used to-day in large-scale commercial operations, with good results. Also, it is the practice to treat off-sulphur casts in the blast-furnace ladle at a number of plants.

It is not known, however, that anyone in the American steel industry has ever adequately equipped a plant for desulphurising blast-furnace metal in an efficient manner as regular operating practice. The purpose of this Paper is to illustrate the importance of correct equipment and proper handling for obtaining uniform and efficient results.

As will be shown, at the temperature of molten iron the alkalis are instantly neutralised by any free slag present, dissipating their desulphurising value. Entrained silicates are rapidly washed out of the metal bath by the highly-basic soda slags and will be satisfied ahead of desulphurising reactions with FeS. More or less of the reagent will always be used up through reactions with the refractory lining. Desulphurisation will be limited to the action of the free alkali then remaining in the slag.

Causes for the erratic results generally found with desulphurising tests in blast-furnace transfer ladles would include, among other things, variations in the quantity of furnace slag coming down with the metal, and differences in the percentage of kish and entrained silicates in the different casts. As the alkalis instantly unite with any free slags or silicates present, these, with any kish coming off, both dilute the reagent and reduce the surface contact between the slag and metal, thereby retarding the desulphurising reactions.

Wide variations in tests with desulphurising between the mixer and open hearth can usually be attributed to variations in amount of kish-slag accumulations in the mixer going out with the pour, rate at which ladles are filled (or extent of agitation by the stream) and time allowed for the reactions.

The foregoing clearly illustrates the impracticability of attempting to desulphurise as a regular practice in the ordinary blast-furnace ladle. However, with the proper equipment and correct handling, uniform desulphurising can be obtained either between the blast furnace and mixer or between the mixer and open-hearth furnaces.

Lay-out for Blast-Furnace Open-Hearth Operation

An ideal lay-out for desulphurising between the blast furnace and mixer includes a ladle car for holding one complete cast, slag-trap spout ladles for multi-stage desulphurising and hoods with exhaust stack for carrying off fumes. This lay-out, with 30-ton ladles, would handle 3,000 tons of molten metal per day. The arrangement provides for more or less complete separation of slag and kish. It also permits of pouring the metal into the desulphurising ladle slowly, thus prolonging the stirring action of the stream in whipping portions of the refining slag down into the metal bath—two prime essentials to efficient desulphurisation.

The special slag-trap spout ladle illustrated by Fig. 1 is equally adaptable for desulphurising between the mixer and open-hearth furnace. Where it is the practice to transfer iron from the furnace in open-top ladles, this type may sometimes be used to advantage. Slag and kish would be held back by the trap when pouring into a second desulphurising ladle of this same design. Desulphurising can be accomplished with ordinary ladies by skimming off the transfer ladle, then slowly pouring the metal into a second ladle to which the reagent has been added and finally skimming off the soda slag. However, the self-skimming ladle will generally produce more efficient results and is much to be preferred.

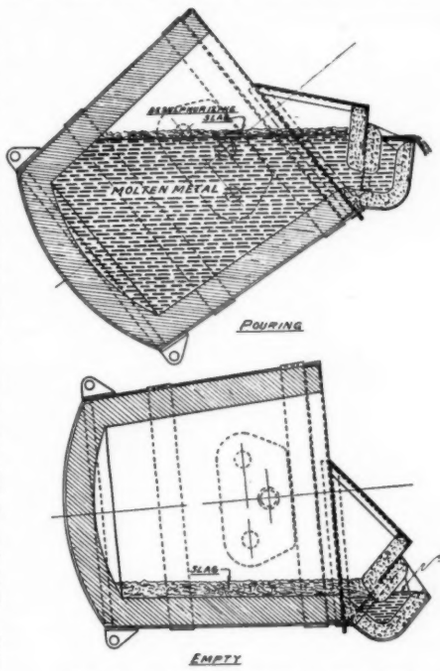


Fig. 1.—Desulphurising Ladle with Slag-Trap Spout.

Top, pouring position. Bottom, empty except for slag, which is held back by slag trap.

Uniform Desulphurising at Low Cost

By knowing the approximate sulphur content of the metal from the furnace, and varying the treatment accordingly, any specifications down to 0.02 per cent. sulphur could be uniformly met, within an approximate range of plus 10 per cent., for widely varying sulphur irons (up to 0.10 per cent.). In other words, a 0.07 per cent. sulphur iron can be reduced by 50 per cent. (0.035 per cent.) within the approximate range of 0.032 to 0.039 per cent., or the same iron can be reduced by 70 per cent. (to 0.021 per cent.) within the range of 0.019 to 0.023 per cent. sulphur, whichever is wanted.

With the proper lay-out, the cost of desulphurising 0.07 per cent. iron to 0.035 per cent. (50 per cent.) and under, including reagent, labour and refractories, should not exceed 1s. 3d. per ton to the Pittsburgh, Chicago or Birmingham districts. For reducing the same iron down to 0.021 per cent. (70 per cent.) and under, the cost would approximate 2s. 6d. per ton or less. Under favourable conditions these cost figures might be reduced by one-half or more.

Early Failures Due to Inadequate Equipment

In the light of past experiences, the foregoing may seem impractical to most or all early experimenters in the steel industry, many of whom have found results so erratic as to discredit the value of desulphurising in practical steelworks practice. Early experiments with desulphurising in the foundry industry were equally unsatisfactory and for the same reason—inadequate or ill-adapted equipment and improper handling. To-day, however, a large proportion of the iron castings produced in the United States are desulphurised, or, more appropriately stated, refined with fused soda ash.

Refining Iron for Castings

Refining in the foundry industry is considered as distinct from desulphurising in duplexing processes, although the same principles apply. While sulphur reductions of 60 to 80 per cent. are regularly being made in the steel industry, experience shows that reductions of only 25 to 40 per cent. usually give the best results in average foundry practice. In this industry the removal of entrained oxide silicates, which are washed out with the sulphur, plays an equal or even more important part in determining the value of improvements in flowing power of the molten iron, and in the soundness and machinability of the finished castings.

Uniformity of results throughout each cast and from day to day is, however, the prime essential to successful desulphurising in foundry operations. The extent to which this is obtained is aptly illustrated in Fig. 2, which shows the log of an 8-hr. heat at a large foundry making cast-iron pipe. Desulphurising was accomplished with fused soda ash in a special elongated teapot refining ladle.

Provided with the proper equipment and with correct handling, equally uniform results can be expected in steelworks practice, for any sulphur reductions required in regular operations.

Multi-stage Process

The slag-trap spout ladle illustrated in Fig. 1 was designed especially for desulphurising by the multi-stage process (patented). In this process an excess of reagent is added to the first ladle in order to build a good volume of slag required for maximum desulphurising efficiency. The partially spent soda slag is held back in the ladle by the slag-trap spout (as shown in Fig. 1), and is revivified by additions of approximately one-third the original amount of reagent for treating the second ladle. The same procedure is followed for the third ladle except that still smaller additions of reagent are usually added. In this way a saving of about 50 per cent. in reagent is made for a given amount of sulphur reduction, as compared to treatment in ordinary lip ladles and skimming off the slag. Moreover, this process of re-using the soda slag makes for uniform results—at minimum cost—from ladle to ladle. This is well illustrated in Table I.

Refractory, or ladle-lining, maintenance costs, which make up from 10 to 25 per cent. of the total cost of desulphurising, average somewhat more with the slag-trap type of ladle, but this usually is offset many times over by the savings in cost of reagent.

Alkalis Available for Desulphurising

The alkalis available for use in obtaining the lower sulphurs required in American open-hearth practice would include, in the order of their activity:—(1) Soda ash (Na_2CO_3); (2) soda ash, caustic mixtures; (3) caustic soda (NaOH).

E

* Paper read before the American Institute of Mining and Metallurgical Engineers. The author is metallurgist with the Mathieson Alkali Works (Inc.), New York.

These chemicals are rated in commercial parlance on the basis of their sodium oxide (Na_2O) content—thus caustic soda with 76 per cent. Na_2O is more active than soda ash with 58 per cent. Na_2O. Limestone and fluorspar are sometimes added with soda ash for treatment of very high-sulphur irons (0.15 to 0.70 per cent. sulphur).

TABLE I.—*Data Taken from Practical Plant Operations.*

Ladle.	Sulphur in iron. Per cent.		Sulphur reduction. Per cent.	Treatment. Lbs. fused soda ash per net ton.
	Before treatment.	After treatment.		
1	0.105	0.041	61	35
2	0.103	0.034	67	+10
3	0.105	0 042	60	+ 5
Average	0.104	0.039	63	16.7

Under favourable conditions, upwards of 85 per cent. of the sulphur present in molten cast iron (0.06 per cent. sulphur or over) can be removed with caustic soda in one treatment without external heat. The maximum reduction obtainable when treating similar iron with soda ash is about 70 per cent. The percentage reductions with treatment of lower sulphur irons would be proportionately less, for the reasons indicated in Fig. 3. Owing to its greater activity, however, variations will be somewhat less with caustic soda. By carrying out the operation in

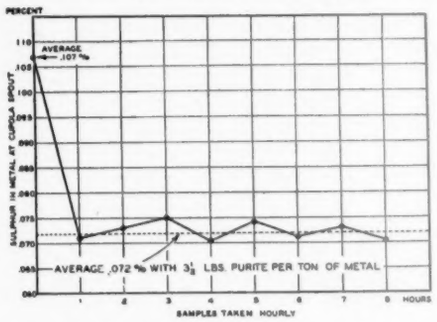

PERCENT
AVERAGE .107 %
SULPHUR IN METAL AT CUPOLA SPOUT
AVERAGE .072 % WITH 3½ LBS. PURITE PER TON OF METAL
SAMPLES TAKEN HOURLY

FIG. 2.—SULPHUR REDUCTION WITH FUSED SODA ASH IN ELONGATED TEA-POT LADLE.

two steps, slightly increased total reductions over the percentages mentioned can sometimes be obtained.

The reagent required for best results would depend somewhat upon the manner of carrying out the operations, but more largely upon the temperature and composition of the metal and the extent of desulphurising required. With temperatures of 1,400 deg. C. and over, straight soda ash could generally be used for desulphurising to the extent of 50 or 60 per cent. of the sulphur present. With lower temperatures, and for uniform reductions of 70 to 80 per cent., mixtures of caustic soda and soda ash will generally prove more efficient. On very low-temperature metals, or for obtaining extremely low sulphurs, straight caustic soda might be required.

Chemical Reactions Involved

The reactions between the metal and soda slag and within the slag, as with open-hearth slags, are both varied and complicated. However, from the standpoint of the end results and for the purpose of discussion, these reactions may be expressed by the following simple equations:—

$$Na_2CO_3 + SiO_2 = Na_2SiO_3 + CO_2 \quad (1)$$

$$FeS + Na_2CO_3 + 2C = Na_2S + Fe + 3CO \quad (2)$$

$$2Na_2S + 3O_2 = 2Na_2O + 2SO_2 \quad (3)$$

$$Na_2S + FeO.SiO_2 = Na_2SiO_3 + FeS \quad (4)$$

It is assumed in this discussion that the major portion, if not all, of the sulphur in molten pig-iron occurs either as iron sulphide (FeS), which is soluble in molten iron, or as manganese sulphide (MnS), an insoluble compound suspended in the metal bath.

Active Reagent Dissipated by Slags and Silicates

Reaction 1 (Na_2CO_3 to Na_2SiO_3) is taken to represent all combinations between the alkali reagent and free slags or entrained silicates in all molten cast iron. This equation also represents reactions of sodium with silicon (FeSi) and corrosion of the refractory lining.

These slags and silicates are all acid-to-alkaline soda slags and not only have a greater affinity for the alkalis than sulphur, but their very nature (with the exception of FeSi in solution) makes for more rapid and intimate contact with the soda slag. Hence it is obvious that this neutralising reaction 1 normally proceeds at a faster rate than reaction 2 (FeS to Na_2S), which is assumed to represent the true or principal desulphurising reaction. The removal of sulphur as MnS, which occurs coincident with and at about the same speed as the reaction with entrained silicates, is considered to be more a mechanical or scrubbing action.

The reactions of sodium with silicates not only occur at relatively faster rates than reactions with FeS, but result in more stable compounds. Once sodium (Na) combines with silicon (Si) in combination with other elements, its value as a desulphurising agent is lost.

Desulphurising Reactions

Reactions 1 and 2, including any reactions with manganese sulphide, may be considered as primary reactions. Reaction 2 is taken to illustrate the true chemical process of desulphurising. These reactions proceed at widely varying rates, depending upon the quantity and condition of siliceous inclusions or free slag present, and upon the percentage of sulphur in the iron. For instance, with an excess of free slag, such as would come down with the molten pig-iron without the use of a skimmer or slag trap in the blast-furnace runner (or when allowing cupola slag to flow out with the metal), the reaction with silicates Na_2CO_3 to Na_2SiO_3 would predominate to the practical exclusion of the desulphurising reaction FeS to Na_2S.

Again, in the absence of any free slags but in the presence of suspended or entrained oxide silicates, reaction 1 still proceeds at a fast rate until all silicates have been satisfied. From this stage on reaction 1 is limited, except for corrosive action on the refractory lining, to any reactions with dissolved silicon (FeSi), and therefore proceeds at a slower rate, more nearly comparable to reactions with FeS.

Desulphurising Varies with Amount of Sulphur Present

Under constant conditions, the speed of reaction FeS to Na_2S varies directly with the amount of sulphur present in the metal. Thus, for a given treatment the "percentage" sulphur reduction will always tend to remain more nearly constant for all sulphur contents, provided an excess of alkali remains; also the "points" sulphur reduced or weight removed will always be greater with higher than with lower sulphur irons. This will be recognised as being in accordance with the law of mass action.

For instance, it is found in actual practice that 10 lbs. of fused soda ash per 2,000 lbs. of molten cast iron (0.5 per cent.), used under favourable conditions of temperature and composition of metal, will ordinarily reduce sulphur from 0.10 per cent. down to about 0.04 per cent. (0.06 points) or 60 per cent. reduction, in one treatment without external heat. The same treatment under similar conditions will reduce an 0.05 per cent. sulphur to about 0.025 per cent. (0.025 points) or 50 per cent. reduction; similarly, 0.025 per cent. sulphur is reduced to about 0.015 per cent. (0.01 point), or approximately 40 per cent. reduction.

This action of soda slags applying in ladle treatment is clearly illustrated by Fig. 3. The lower curve is projected to show the approximate percentage reduction and pounds of sulphur removed, by 10 lbs. of fused soda ash per short ton of molten iron with sulphur contents varying from 0.10 to 0.01 per cent. The reduction indicated represents about average expectancy in actual foundry practice, under favourable conditions and with proper handling. (Data from which the chart is plotted were selected from practical operating results, including some tests on electric-furnace iron.)

Importance of Correct Handling with Low Sulphur Irons

The gradual loss in "percentage reduction" with lower sulphur irons, as indicated by the chart, is attributable to: increase in the ratio of slag and/or entrained silicates to total sulphur present; relative effect of reactions with the lining and FeSi in reducing the activity of the slag, compared to percentage of sulphur present; and effect of temperature drop upon reactions in relation to percentage of sulphur in the iron.

One purpose of Fig. 3 is to show the relatively greater effect of any free slags or entrained silicates, and/or improper handling upon the results obtained with low *versus* higher sulphur irons. To illustrate: assume a condition wherein 10 lbs. of reagent would reduce a 0.07 per cent.

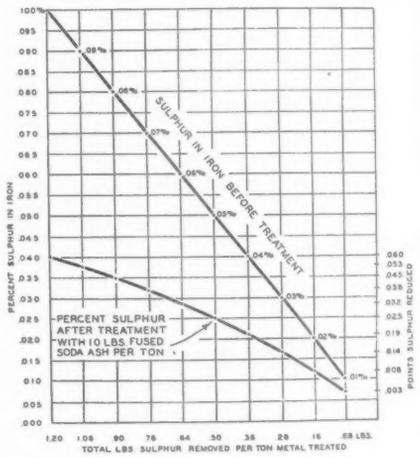

PERCENT SULPHUR IN IRON
SULPHUR IN IRON BEFORE TREATMENT
PERCENT SULPHUR AFTER TREATMENT WITH 10 LBS. FUSED SODA ASH PER TON
POINTS SULPHUR REDUCED
TOTAL LBS. SULPHUR REMOVED PER TON METAL TREATED

FIG. 3.—NORMAL SULPHUR REDUCTION BY 10 LBS. SODA ASH PER TON OF MOLTEN METAL WITH VARYING SULPHUR CONTENTS.

sulphur to 0.042 per cent., that is, 40 per cent. reduction instead of 54 per cent. as in the chart. Under similar conditions it is calculated that an 0.035 per cent. sulphur iron would be reduced only about 25 per cent. or to 0.026 per cent., as compared to 0.019 per cent. in the chart. Thus the necessity for correct handling is evident, especially when treating lower sulphur irons or when attempting maximum desulphurisation of higher sulphur metal.

Oxidation of Sodium Sulphide

Reaction 3 (Na_2S to SO_2) represents any conversion of sulphides in the slag to gaseous sulphur compounds, which escape into the air, and to represent oxidation at the slag surface. The speed of this reaction, as indicated by the amount of sulphur fumes evolved, varies widely with changing conditions.

Observations made in practical open-hearth operating tests, when pouring the desulphurising slags into the hot furnace along with the molten iron, indicate that most of the sulphur held in the sodium slag is immediately oxidised to SO_2 and passes off in the furnace gases.

Reversion of Sulphur from Slag to Metal

Reaction 4 (Na_2S to FeS) is taken to represent all manner of reversion of sulphur from the slag back into the metal bath. The speed

of this reaction, expressed in terms of its effect upon percentage of sulphur in the metal bath, increases as total acids increase in the slag. Conversely, desulphurising gradually slows up as the slag is acidified, until finally the effect of reaction FeS to Na_2S would be overbalanced by the reverse reaction "Na_2S to FeS." This results in a net increase in the return of sulphur back from the slag or a rise in sulphur content of the metal. With deep baths such as in ladle treatment, where the slag-metal-surface area is small in relation to the mass of metal, the reverse reaction is of relatively minor importance in determining the final sulphur. In shallow baths, however, as in air-furnace desulphurising, where the metal depth varies from 10 in. to zero and where the slag is acidified by roof drippings and corrosion at the slag line, the end results may be affected in large part by reversion of sulphur from the slag back into the metal bath.

It will be understood that any or all of the reactions go on in the slag and between the slag and metal bath at one and the same time. The foregoing is intended simply to illustrate the combined effect of all reactions upon the sulphur contents of the metal bath, at various stages during the progress of desulphurisation.

Reactions Illustrated by Air-Furnace Test

Something of the speed and order of the combined effects of the various reactions is well illustrated by data obtained some years ago in a series of desulphurising tests carried out in air-furnace practice. In these tests the furnace slag was thoroughly skimmed off and 150 lbs. of fused soda ash (10 lbs. per ton of metal) was added to the bath. Iron and slag samples were taken at 3-min. intervals over a period of 18 min. and analysed. The results are shown in Table II and illustrated by curves in Fig. 4. It is apparent in this test that most of the initial drop in sulphur from 0.091 to 0.063 per cent. during the first 3-min. period was due to direct absorption in the soda slag of suspended manganese sulphide. This is indicated by the sudden increase of MnS in the slag from 0.24 to 4.78 per cent. within this period. After suspended sulphur compounds were washed out, removal of sulphur was limited to reactions FeS to Na_2S and/or MnS to Na_2S, which continued at a slower and gradually decreasing rate, to a maximum percentage reduction at about 10 min. From this point on there was a gradual return of sulphur from the slag back into the metal bath, Na_2S to FeS, as the percentage of silicates (total acids) increased in the slag.

The reversion of sulphur from the slag back into the metal bath would be accelerated in an air furnace; first, by the continued boiling action caused by the flame and, second, by the relatively large metal-slag surface area in relation to the total mass of metal. However, with practical desulphurising operations in a 30-ton ladle, where the slag gradually quietens down as the reactions proceed and where the ratio of slag-metal surface to the total mass of metal is limited, this reaction (Na_2S to FeS) would actually play a very small part in determining the final sulphur contents.

Affinity of Soda Slags for Silicates

The sudden increase of silicates (SiO_2, FeO, Al_2O_3) in the slag—from 22 to 59 per cent.—and the increase in MnS from 0.24 to 4.78 per cent. during the first 3-min. period of the test clearly illustrate the pronounced affinity of soda slags for silicates and the very rapid rate at which entrained compounds are washed out of the metal bath by the alkali slags.

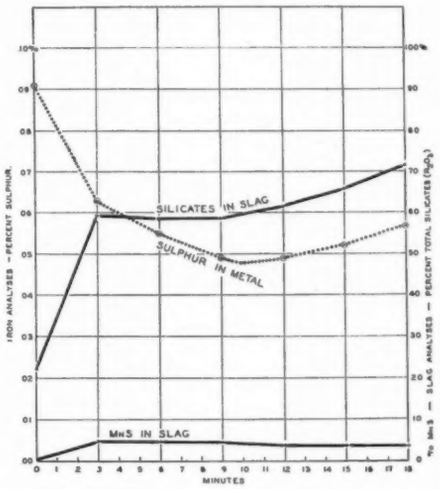


Fig. 4.—Progress of Desulphurising (Air-Furnace Practice) with 10 lbs. Fused Soda Ash per Ton of Metal.

The rapidity of the reactions with silicates, compared to the slower reactions with FeS, explains how the presence of free slag and entrained silicates always decreases the percentage of sulphur reduction. As Fig. 3 shows, this effect is more pronounced with lower-sulphur irons. With excess silicates, sufficient to more than acidify the slag, reductions in sulphur will be limited mostly to that removed by absorption of MnS in the slag bath. Even small amounts of silicates tend to "kill" the slag, thereby retarding the reactions.

Table II.—*Progress of Desulphurising in Air-Furnace Tests.*

Sulphur.	Before treatment. Per cent.	After adding 10 lbs. fused soda ash per ton. Per cent.					
		3 min.	6 min.	9 min.	12 min.	15 min.	18 min.
Sulphur in metal	0.091	0.063	0.055	0.049	0.049	0.052	0.057
Points removed	—	0.028	0.036	0.042	0.042	—	—
Points returned to metal	—	—	—	—	—	0.003	0.008
Reduction, net per cent.	—	31	40	46	46	43	37

Slag Analysis.

Composition.	Initial soda slag.						
SiO_2 in slag	14.03	45.96	45.97	45.26	46.71	50.63	55.76
FeO in slag	3.68	5.24	5.37	5.89	5.85	6.28	6.61
Al_2O_3 in slag	4.37	8.01	7.41	7.37	9.03	9.10	9.33
Silicates	22.08	59.21	58.75	58.42	61.57	66.01	71.70
MnS in slag	0.24*	4.78	4.83	4.17	3.77	3.70	3.59

* All Mn in the slag reported as MnS.

Effect of Various Elements upon Reactions

Authoritative data on the effect of the normal elements occurring in cast iron upon the reactions of soda slags is limited. It may be assumed, however, that all elements, to the extent that they may add needed fluidity, act to promote the reactions. Manganese promotes desulphurisation (Table II); its effect is pronounced, at least to the extent that it exists as insoluble MnS or reacts to form it. Though an aid within certain limits, high manganese is not essential to successful desulphurisation.

Carbon when present in the amounts occurring in ordinary cupola metal (3.25 to 3.50 per cent.) serves to promote the reactions. Low-carbon cupola metal is more difficult to desulphurise, and no desulphurisation of steel will generally result with ladle treatments. However, the alkalis accelerate the desulphurising reactions of basic open-hearth slags. Excess carbon in molten pig-iron that would be thrown out as kish has a retarding effect, as previously explained.

It is believed that the action of carbon in promoting desulphurisation (with alkali slags) is due primarily to its effect in controlling fluidity rather than to any part in the chemical reactions. No determinable loss of carbon occurs with desulphurisation. If any, it is so small that it will not generally show in commercial laboratory check determinations of samples before and after treatment.

The percentage of combined carbon in ordinary cupola cast iron (1¼-in. test-bar) will be gradually lowered with desulphurising to the extent of 25 to upwards of 60 per cent. of the sulphur present, but will be increased with further desulphurisation. This is due no doubt to the predominance of oxidising reactions occurring with the excess of free alkali required for maximum desulphurisation.

The alkalis react with silicon (FeSi) held in cast iron to form silicates. To that extent, silicon consumes reagent, and more, tends to kill the soda slag. Thus any excess silicon over that serving to increase fluidity and promote contact between metal and slag may act to retard desulphurisation.

Effect of Smelting Practice

It has been observed in practical operations that irons melted or made with high-lime (basic) slags are more difficult to desulphurise than irons of similar composition made with more acid slags. Several theories have been suggested as explaining these phenomena—to what extent it exists and why are not known. However, desulphurising would appear to be more efficient or less costly when applied to blast-furnace metal made with lean slags.

Time Required for Reactions

Time required for completion of the reactions will vary widely. It may range from a minimum of 4 min. upwards, depending upon the extent of desulphurising required, the manner of carrying out the process and the activity of the reagent. From the explanations of the reactions it is seen, however, that the operations should always be carried out as quickly as possible.

Promoting Contact Between Slag and Metal

The most important factor in efficient desulphurising, apart from temperature and the reagent itself, is rapid and intimate contact between slag and metal bath. In the absence of heat over the slag bath, boiling or stirring action can be effected in large-scale operations only in one or two ways: (1) by the composition and/or form of the reagent; (2) by the stream of iron flowing into the bath.

As previously mentioned, the stream of iron flowing into the desulphurising ladle promotes slag-metal contact. This results both from the physical effect of the stream in stirring the metal and from its action in whipping portions of the refining slag down into the metal bath. This not only increases the amount of surface contact between metal and slag but also makes for more effective contact because of the pressure of the overlying metal. Moreover, decomposition of the reagent under the metal surface, with the consequent evolution of gases, acts to enhance surface contact.

(*Concluded on page 267.*)

Selection of Refractories*

By BERNARD THOMAS

In the category of low-temperature furnaces, fired either mechanically or by hand with solid fuel, are included certain types of billet-heating furnaces for stampings, mould-heating furnaces for light forgings, oven types for reheating or soaking of blooms and annealing ovens. The temperatures which may be involved are somewhere between 900 and 1,200 deg. C., and the fires do not, under ordinary circumstances, have to contend with slagging metal. Such furnaces may often be run for six months to two years before a complete rebuild is necessary.

A good Stourbridge brick is usually quite satisfactory for the forging class of fire, the main evils to guard against being spalling and localised areas of iron oxide. Bricks with high porosity appear to resist spalling better than many standard types, as also do those which are not fired too hard during manufacture. Spalling is most certainly the bane of the firebuilder and user. To link up the connection between spalling and grog it should be explained that excessive shrinkage during the drying or burning operations of firebrick manufacture is apt to lead to cracking. Failing this, they may be left in a state of great strain which affects their strength, even when cracks cannot be seen. On putting such bricks into service the constructional and thermal strains involved will reveal their weakness by the appearance of cracks—otherwise known as spalling.

Purpose of Grog

The purpose of grog is to lessen the shrinkage. This it is capable of doing proportionately to the amount present by the simple expedient of increasing the percentage of non-plastic matter. By this means, the risks of cracks or strains during drying and burning is lessened, with the result that a brick is obtained capable of withstanding sudden changes of temperature without damage. It is wise, therefore, for the types of furnace under discussion, to choose bricks with a high grog content for the reasons already outlined. Coarseness of the grog particles is an added advantage, as larger pellets ensure, for a given weight, a small surface area, which in its turn calls for a less quantity of bond to carry out the coating. One particular brick obtainable in the Birmingham district which is extremely successful from the non-spalling viewpoint contains ¼ in. particles of grog consisting in the main of crushed semi-silica bricks, containing 85 to 90 per cent. SiO_2.

As regards the iron oxide, it is agreed generally that areas of such are zones where disintegration commences. Certain of the deposits of clay in the district offend in this respect, and bricks of this character should not be expected to give long service.

Table I gives typical analyses of Stourbridge bricks. Those marked A and B are the better,

Table I.—*Typical Analyses of Stourbridge Bricks.*

	A.	B.	C.	D.
Silica ..	60.52	69.76	58.20	53.80
Alumina ..	33.81	25.56	34.88	39.21
Iron oxide ..	2.22	1.79	3.19	2.72
Titanic oxide	1.14	1.00	1.90	1.60
Lime ..	0.65	0.60	0.57	0.30
Magnesia ..	0.51	0.38	0.51	0.71
Alkalis ..	1.15	0.85	0.71	1.35
Ignition loss	—	0.06	0.20	0.21

while C and D represent a lower-priced grade designated usually as B quality. It will be noted that the iron oxide averages almost 1 per cent. higher in the lower grade brick, while the other main differences consist of a lower silica and higher alumina content as compared with the No. 1 quality, that is, grades A and B. It should not be assumed, however, from these analyses that all high-alumina bricks are to be avoided, as, quite apart from the sillimanite types, some of the best Scottish bricks average 42 to 44 per cent. of alumina.

High-Temperature Furnaces

With reference to high-temperature solid-fuel furnaces, where the description "high-temperature" automatically precludes the question of hand-firing, such furnaces are largely a development of recent years. They may be divided into two classes—pulverised fuel and mechanically stoked. Their scope includes forge fires for heavier stampings direct off the billet, oven- or muffle-type fires for heating slabs for heavy forgings, continuous and ingot-heating furnaces for bar-rolling mills, nut and bolt forging fires and certain types of welding fires for tube and edge-tool manufacture.

Lower-grade bricks are rarely successful in pulverised-fuel furnaces as they are generally of a nature too soft to withstand the erosive conditions which exist. It is necessary to choose bricks of high refractoriness with figures of the order of 1,750 to 1,770 deg. C., and capable of retaining a high degree of hardness at such temperatures. These requirements may be met successfully by refractories containing a rather higher content of alumina, that is, 42 to 44 per cent. Typical analyses of three such types are given in Table II.

Table II.—*Typical Analyses of Alumina Bricks.*

	A.	B.	C.
Silica	53.51	51.62	51.29
Alumina	42.44	42.44	42.00
Iron oxide	2.60	1.89	2.65
Titanic oxide	1.10	1.47	3.11
Lime	0.40	0.41	0.18
Magnesia	0.50	0.29	0.21
Potash	0.10	0.62	0.63
Soda	Trace	0.22	0.20

In pulverised-fuel furnaces where a certain amount of flame impinges it is often advantageous to build an arch of refractories containing the true sillimanite clay. Such bricks may vary from 55 to 90 per cent. of alumina and are extremely successful in resisting severe service conditions. One type of brick in particular which fully justifies its high cost contains 56 per cent. alumina, 41 per cent. silica, with iron oxide, magnesia and alkalis totalling 1.7 per cent., and with a refractoriness approaching 1,800 deg. C.

With the erosive conditions of the pulverised-fuel furnace absent, it is not as a rule necessary to go to the expense of the aluminous grade bricks in furnaces fired by mechanical stokers. For the main structure of sides and ends a well-burnt brick with coarse grog and high porosity, and containing 33 to 34 per cent. alumina is usually very satisfactory. In the combustion chamber, however, these normal types of brick are short lived, but a siliceous brick will give excellent results.

It may be well to qualify the term "siliceous" as opposed to the usually-accepted silica brick. No one would doubt the wisdom of using the standard 95 to 96 per cent. silica refractories in large furnaces such as the open-hearth for steel making, but place them in a small furnace which is worked only 8½ hrs. out of each 24, and trouble through spalling will develop inevitably. It is a curious fact that by lowering the silica content to slightly below 90 per cent., spalling is almost entirely eliminated in small-size furnaces. Hence, although the bricks are high in silica content, the author prefers to refer to them as siliceous, rather than silica, to avoid confusion. It should not be taken that any brick of approximately 90 per cent. silica will suffice for the foregoing purpose, but they should be chosen carefully with low contents of iron oxide and alkalis, coupled with a porosity of 26 to 27 per cent. The following analysis is of a grade of siliceous brick, which, in a furnace designed by the author, gives regularly 3½ times the life of the previous best of many other grades tried:—Silica, 89.50; alumina, 8.10; iron oxide, 0.70; titanic oxide, 0.70; lime, 0.24; magnesia, 0.13; alkalis, 0.40; loss on ignition, 0.02; refractoriness, 1,670 deg. C.; porosity, 26.4 per cent.

In certain cases, arches of silicon carbide may be employed, with their high refractoriness approaching 2,000 deg. C. It is necessary, however, to ensure that the furnace structure is capable of withstanding the greater weight involved and that economic considerations will permit of the greater financial outlay.

Steel-Heating Furnaces

With ferrous work, where temperatures up to 1,450 deg. C. are sometimes employed, trouble may be experienced on the furnace bottom from slagging. Sand is not satisfactory as a covering medium, as the grains of sand adhere to the heated metal, causing damage to dies and tools. The obvious refractory for this purpose would be something in the magnesite or chrome line, that is, an 85 per cent. magnesia content, or alternatively 40 per cent. chromic oxide—20 per cent. magnesia. Unfortunately, both these types of bricks fail badly in service through spalling, but fortunately in the last few years it has become possible to obtain refractories which contain as their basis one of the mineral spinels. Ordinary and most common of the spinels is magnesium aluminate of the formula $MgAl_2O_4$. There is, however, a branch of the family containing chrome, sometimes known as picotite, which is reputed to have the formula $(Mg.Fe)(Al.Fe.Cr)_2O_4$. Bricks produced from the above natural mineral resist spalling to a surprising degree, being a much superior refractory to the ordinary chrome or magnesite prototypes. Although when placed on the hearth or floor of a heating chamber wherein slagging occurs, they do not prevent the slag forming, these bricks have the ability of absorbing the slag in such a manner as to maintain a surface dryness so satisfactorily, that trouble is no longer experienced from the slag adhering to the metal sections being heated. Typical analysis of such spinel-base bricks is given in Table III.

Table III.—*Typical Analyses of Spinel-Base Brick.*

	A.	B.
Magnesia	35	39
Chromic oxide	25	24
Alumina	17	16
Iron oxide	14	14
Silica	7	5
Refractoriness-under-load ..	1,560 deg. C.	1,600 deg. C.
Porosity	19 per cent.	22 per cent.

Up to a certain point the greater cleanliness offered by gas-heated furnaces in comparison with solid fuel, provides less difficulty in the choice of refractories. The qualification becomes necessary in respect of furnaces employing the use of forced-draft.

Metallurgical Furnaces

In industrial service, temperatures of metallurgical furnaces working on natural draft rarely exceed approximately 1,000 deg. C. Included in this category are core-ovens, general heat-treatment equipment of both continuous and fixed design, and most muffle types. In the case of core-ovens a hard, well-burnt brick of good shape, containing 33 to 34 per cent. of alumina is all that should be necessary for all positions. In muffle-type furnaces it is regular practice to use Scottish bricks with their 42 to 44 per cent. of alumina, though the author has found it

* From a Paper read before the Midland Metallurgical Societies on September 28.

necessary to go to the other extreme and employ a siliceous brick. Where muffle bottoms suffer from the abrasive action of charging and discharging it is helpful to use silicon carbide which resists such action most successfully. The spinel-base refractories are not to be recommended, as their resistance to abrasion is low.

With low-pressure forced draft up to say ½ lb. pressure, the majority of the refractories given for natural-draft designs are usually suitable in the absence of any flame impingement. For higher temperatures, and pressures up to 2 lbs., none but the best refractories are likely to survive. In the vicinity of flame impingements silicon-carbide refractories probably offer the best service with sillimanite next in the list. As a rule neither silica nor siliceous bricks are very successful under such conditions.

Conditions in oil furnaces, being less clean, are apt to be more arduous than gas. Although some users advocate bricks with an alumina content of 42 to 44 per cent., the author's experience has been that under most conditions the walls are best served with refractories where that constituent does not exceed 36 per cent. As most oil furnaces probably reach operating temperature in less time than by any other means of firing, it is natural that bricks highly resistant to spalling must be employed. Such a brick is the high content and coarse grog brick described under the heading of low-temperature solid-fuel fires. For the arches, the siliceous type has much to be said in its favour.

Referring back to silicon carbide, such refractories usually call for added strength in the furnace design in general and so create unfavourable disadvantages. Should the design, however, be such as to allow of their incorporation, their use is to be recommended. Further points of application which suit the use of silicon-carbide bricks are the shaped burner blocks and also false bottoms to low-temperature oil fires, where the actual combustion takes place in a separate chamber situated beneath that used for heating. The division is made of loosely-placed and spaced silicon-carbide bricks, which, having a thermal conductivity of roughly seven times that of ordinary firebrick, allow the heat to travel through from the combustion chamber probably better than any other means.

Insulating Materials

Too frequently when refractories are discussed insulation is loosely included in the category. The author prefers to regard insulation as an entirely separate commodity which may be used in conjunction with refractories if, and when, desired. Insulating materials for use in metallurgical furnaces may be said to serve a dual purpose. Primarily the main object is to reduce losses through radiation, but a secondary consideration, which is of some importance, is to increase the efficiency of the furnace in a manner calculated to obtain either higher temperatures or greater outputs than were possible previously. It is perhaps unfortunate that the types of insulation which have the highest values are only suitable for withstanding face temperatures up to approximately 1,000 deg. C. These are the natural grade. By admixing a proportion of refractory material and firing it, it is possible to obtain bricks which are satisfactory up to about 1,350 deg. C., but with corresponding decrease in insulating value.

The objective must be to prevent the emission of heat by radiation from the outer walls of the furnace by placing there some form of material which has a very low relative thermal conductivity. Diatomite or diatomaceous silica is the material most generally used for this purpose. Diatomite consists of the fossilised skeletons of minute marine organisms which have lain undisturbed for many centuries. In composition it is practically pure silica with a melting point of approximately 1,590 deg. C. For face temperatures up to 900 deg. C., the natural rock or earth may be used in its natural condition, the only treatment given being drying. This form has the very highest of insulating values and should be employed whenever possible for best results. It is necessary to handle the dried earth with care as there is a tendency for it to shale in fashion similar to mica. Some manufacturers prefer to market their product in the form of lightly-burnt bricks or blocks. This has the advantage of reducing both shrinkage and shaling difficulties. Where face temperatures are required to withstand up to 1,350 deg. C., the diatomaceous silica is ground, pugged, pressed and fired in kilns.

As a guide to the thickness of insulation advisable to employ, coal and oil furnaces may be dealt with satisfactorily with 4½-in. to 9-in. walls. Gas furnaces, particularly those running at high temperatures, should have up to 14 in. Where electricity is used, however, anything up to 18 in. is to be strongly recommended.

Broken Hill Developments

A hint that Australia may soon wrest from India the steelmaking supremacy of the British Empire was given by Mr. K. Butler, assistant manager of the Broken Hill Proprietary, in a statement made recently at Newcastle, New South Wales. The Broken Hill plant is at present the second largest in the Empire, being exceeded only by that in India. Production at the company's Newcastle works is increasing annually and it is predicted that next year it will be able to eclipse the production at the Indian works.

The steady growth of the Broken Hill Proprietary works at Newcastle is mainly attributable to the plentiful supplies of raw materials available and to the firmness of domestic demand for its products. Iron ore is obtained from Whyalla, about 1,200 miles from Newcastle. A ship is loaded daily at Whyalla for Newcastle and Port Kembla. Limestone is brought from Tasmania, and most of the coal comes from collieries in the vicinity. More than 1,900,000 tons of coal are consumed annually by the Broken Hill steelworks—approximately 20 per cent. of the Commonwealth's total coal production.

About 2,800 tons of steel are produced daily at the Newcastle works and Australia consumes the whole and could easily take more. The company is faced with the problem of fulfilling all orders in contract time. Broken Hill Proprietary now consumes 30,000,000 cub. ft. of gas daily.

Among the B.H.P.'s subsidiaries, Lysaght's works produce 250,000 sheets of galvanised iron per week, while Stewarts and Lloyds make enough of a certain type of tubes to form a pipeline from Newcastle to Sydney. Together with its subsidiaries, the company now employs 24,000 people and pays £6,250,000 wages annually. Extensions of the works are constantly in progress. The company has erected its own power station, and in 1939 it will replace the steam machinery in the rolling mills with electric motors.

"Sheffield" as Trade Mark

A United States firm, it is revealed in the annual report of the Sheffield Advisory Committee of the Cutlers' Company, is opposing an application by the Cutlers' Company to register the word "Sheffield" as a Community Trade Mark in the U.S.A. The necessary steps for contesting the opposition are being taken, the report states. The word "Sheffield" has been registered in England as a Community Trade Mark in various classes in the name of the Cutlers' Company from 1920. Until an amendment in the American Trade Mark Law of 1905 was made in 1936, however, it was impossible to register a Community Trade Mark in the United States. Instances have occurred, states the report, where the word "Sheffield" has been used in such a way as to represent or imply that articles made in the U.S.A. have been made in Sheffield, England.

Company Meeting

Thos. W. Ward, Limited

The annual meeting of Thos. W. Ward, Limited, was held in Sheffield on Friday, September 30. Mr. Joseph Ward, J.P., in his address to the shareholders, said that on the whole the company had experienced a very successful year. While some departments had not been satisfactory, most had added their quota to the general result, and some in marked degree had made exceptional progress and contributed substantial revenue. The scrap agency control had generally worked satisfactorily. The lavish buying of imported semi-manufactured steel during the 12 months to June 30 last, representing 2,417,227 tons, against 1,385,531 in the previous corresponding period, together with the abolition of import duties, had had an adverse effect on the iron and steel industry in the last six months, and, in his opinion, largely accounted for the slowing down of iron and steel production in recent months. A more careful estimate of the country's actual requirements would have eliminated the abnormal stocks that had occurred in the rolling mills, which, with diminished demands, were now being slowly consumed. Financial provision for the carrying in this country of much heavier stocks of raw materials, such as scrap and pig-iron, would represent a sound economic policy and largely obviate the need for importations, which had generally to be acquired at very high figures. At the beginning of the financial year they were invited to take an interest in the Darlington railway plant and foundry works. After full investigation they were convinced that, with reconstruction on an equitable basis and with control, the company could be made revenue producing. Reconstruction took place, in the course of which the Darlington company's debt to the bank was liquidated. They looked with confidence to this latest addition bringing its fair quota of revenue to the company. Low Moor Best Yorkshire Iron, Limited, the Midland Iron Company, and George Cooper & Sons had shown very satisfactory results from the year's trading. The rail department had a busy year, particularly in connection with the supplying and laying of railway sidings in all parts of the country and abroad. At the present time they were engaged in laying a railway siding which was the largest they had ever supplied, at an important works in the north of England, comprising about 35,000 yds. of track and 200 complete turnouts, including the ballasting. The Ketton Portland Cement Company, Limited, had had a busy year, and Ribblesdale Cement, Limited, had also been able to sell the whole of their production. The turnover of their business, including subsidiary and associated companies, had reached nearly £6,000,000, and represented a tonnage of practically 1,750,000. Mr. Ashley S. Ward (managing director), who also addressed the meeting, said that they had been busily engaged in dismantling, though with the extensive use of present equipment no very large undertakings had come into the market. They acquired for dismantling purposes the works and plant of the Haslam Foundry & Engineering Company, Limited, at Derby, and they had recently acquired the blast-furnace plant of the Low Moor Iron Company. They were still holding as the company's property the blast-furnace plant of the Langloan Iron & Chemical Company at Coatbridge. Reference had been made previously to the purchase of the old undertaking of the Widnes Foundry & Engineering Company, Limited, which was entirely owned by the company. The Widnes Company were busy and operating successfully during the year; the machine shops, foundry, and complete equipment had been modernised, and would, he thought, be in complete operation in a couple of months. Mr. George Wood, discussing the arrangements made for the control of scrap iron and steel, said that criticism had been provided in abundance, but those who knew the facts had no hesitation in saying that the scheme had been a marked success and had coped with a very difficult problem over a dangerous initial period in a much more satisfactory manner than could have been reasonably expected.

The directors of Parkinson & Cowan, Limited, announce that the company's debenture stock conversion scheme was adopted at the meeting of stockholders on September 29. The option to convert was exercised by a great majority of the stockholders.

Some Fundamental Properties of Moulding Sands

A LECTURE BY Mr. W. J. REES

The final lecture of a series given by Mr. Rees to the Lancashire Branch of the Institute of British Foundrymen, over which Mr. R. A. Jones presided, dealt with the underlying principles which govern the choice of a moulding sand for any particular purpose. Details of research work undertaken during the war and designed to make this country independent of imports are disclosed.

The study of the essential properties of foundry sands is comparatively recent, but during the past few years much work has been done to place the subject on a sound foundation. Personal acquaintance with moulding sands really began through a shortage of sands, during the wartime years, for use in steel foundries. A great deal of the practice in British steel foundries had in pre-war years been built up on the use of the Belgian and French moulding sands. It became very difficult to obtain adequate supplies of those sands during the war period, and it became necessary that the foundries should endeavour to obtain suitable supplies of sand in this country. This task was by no means easy, and was made more difficult because the knowledge available with regard to moulding sands at that time was very small indeed. A start had to be made with a study of the characteristics of the moulding sands for the steel foundry before a search for useful substitutes could be made.

This research work was very successful. The man who did the major part of the work was Professor P. G. H. Boswell, Professor of Geology at Liverpool, when he was attached to the Ministry of Munitions. He supervised the very important work in connection with moulding sands for steel. As a result of that work, it cannot be said that the steel foundry is independent of imported sands, because they are still used, but it could be independent of them, which is the most important thing. If the need arose tomorrow, the steel foundry industry could manage without any imported sands. This is obviously a very important matter in these troublesome days.

Although the knowledge of the fundamentals of the subject of moulding sands is still far from complete, enough is now known to enable the quality of moulding sands to be assessed with reasonable accuracy. The essential properties of moulding sands are the same whatever metal is being cast, no matter whether it be steel, iron or non-ferrous.

Consideration has to be given to characteristics other than these essential ones where sand has specialised uses. It is found, of course, that the results obtained with any particular sand will naturally vary not only with the metal cast, but with different foundries. Differences of practice in foundries do result in differences of casting with a particular sand.

Fundamental Properties

The most important properties of a moulding sand are plasticity, the size and shape of the sand grains, the nature of the grain surface, the green and dry strength, the permeability and the refractoriness. These properties are, to a very great extent, interdependent. The particular behaviour of a sand in one direction will be influenced by its behaviour in another direction. From childhood days, everybody has a good idea of the type of material termed a plastic material. It is a material which can, by pressure, be formed into any desired shape, and that shape is retained when the pressure is removed. That, of course, differentiates quite clearly between a plastic body and an elastic body.

Plasticity

In the case of sands, the plasticity is primarily due to the presence around the sand grain of a film of water. Sand castles on the seashore, when exposed to the sun, gradually crumble away as the early plasticity completely disappears. With moulding sands, however, the water is retained by a film of clay which surrounds the sand grain. That film of water is retained by the clay sticking to the sand grain, thus enabling the moulding sand to retain its plasticity and to maintain a greater or lesser degree of green strength. If the plasticity is due to water alone, it is completely destroyed by drying. If it is due to water associated with a film of clay it is also destroyed to some extent by drying, but it is very materially destroyed by burning. When a moulding sand is heated, the cold material, after heating, is no longer plastic to the same extent.

If a moulding sand is heated, say, to 200 deg. C., as it is in the making of a dry-sand core or mould, and then one powders the material and wets it, it will be found that a good deal of its plasticity can be restored. But if the same sand is heated to a little beyond 500 deg. C., and is again powdered, and water is added to work it up, it is found that the plasticity is not restored; it has been definitely destroyed. That is due to the fact that a chemical change takes place in the clay at a temperature between 400 and 500 deg. C., and, in its new form, the clay will not take up the water film. The clay itself will not become plastic.

Rehydration of Clay Content

This, of course, is important in the foundry. It is well known, of course, that floor sand will no longer develop the same plasticity as new sand. That is due, primarily, to the fact that if it has been heated beyond the temperature of 500 deg. C. the chemical change takes place. There is a complete dehydration of the clay substance, and it will no longer take up water. It is known, from laboratory study and still more from practical use, that the red sands are not destroyed to the same extent as the whiter sands. The colour of a red sand is due almost entirely to the presence of hydrated iron oxide. When the hydrated iron oxide is heated, its ability to take up water is not destroyed at quite the same rate as that of the clay itself. So that a ferruginous clay, *i.e.*, a sand containing not only some clay but also some iron oxide, is a rather more permanent sand than one containing clay only.

This, naturally, is of particular importance where one is dealing with synthetic sands. A great deal of the experimental and research work at the present time is concerned with the production and characteristics of synthetic sands; not merely for the steel foundry, where a considerable amount of interest is being evinced in synthetic sands at the present time, but in the ordinary iron foundry, and especially in mechanised foundries, where it is found that a greater degree of control of the sand can be exercised with synthetic sands with a particular type of clay bond than can be exercised with any of the naturally-bonded sands.

Grain Size of Moulding Sands

When expressed graphically there are several grain sizes depicted, namely, a gravel which is over $\frac{1}{12}$ in.; a very coarse sand between $\frac{1}{12}$ and $\frac{1}{25}$ in.; a coarse sand between $\frac{1}{25}$ and $\frac{1}{50}$ in. in average grain size; a medium sand—$\frac{1}{50}$ to $\frac{1}{100}$ in.; a fine sand—$\frac{1}{100}$ to $\frac{1}{150}$ to $\frac{1}{300}$ in.; a silt; one between $\frac{1}{2000}$ in., and a clay grade which gives a sand its plastic character and is of less than $\frac{1}{2000}$ in.

In a sand which is of a 30-mesh size, namely, where the grains are something between $\frac{1}{30}$ and $\frac{1}{60}$ in., in a cubic inch there are 240,000 grains. As the mesh decreases the grain size becomes smaller and the number of sand grains in a cubic inch increases enormously. In a cubic inch, the sand grains which are of 120-mesh size number 16 millions. These figures are reasonably accurate.

From the point of view of the strength of the sand, the important thing is the number of contacts of sand grain to sand grain in a cubic inch. It will be observed that, as the grain size of the sand decreases, the number of contact points enormously increases. This, of course, has some rather important implications. As the grain size decreases, so the amount of surface which has to be covered by the bond increases, and in order to get the same strength it may be necessary to have actually present a rather higher proportion of the bonding material if there is to be a proper covering of the whole of the grain surfaces.

The total surface area in one cwt. of 30-mesh sand is just over 3,000 sq. ft. With finer sand of 120 mesh there would be an enormous increase in the actual surface area. The actual thickness of an oil film on a grain of sand using the oil in the proportion of one of oil to 40 of sand presents features of interest. With a coarser sand, there may be one-thousandth as the thickness of the oil film, but with a fine sand there might be an oil film of less than one-fifth that thickness. These are factors which have to be seriously considered when dealing with much-used sand mixtures.

Permeability

One of the most important of the fundamental properties of a moulding sand for any use, no matter what type of metal is being cast, is its permeability. An expert who visits a great many foundries has told the author that more foundries have gone out of existence through lack of proper attention to permeability than from any other cause.

Permeability depends, to some extent, on the shape of the sand grain, but it depends to a very marked extent also on the actual grading of the sand. The ideal sand, merely considering permeability, would be one which was built up of grains which are perfectly round and all of one size. The sand grains pack themselves, leaving spaces between them so that the permeability is very high.

In nature, sand of that type is comparatively rare, though by somewhat difficult screening operations rounded sands of one grain size can be obtained, but they are not the ordinary commercial sort of material.

If sand grains of varying sizes are mixed together, the mixture will not be a good packing material, and the permeability will be reduced. What is needed is sand of more or less one grain size, with very little of the material to clog up the pores, and just sufficient clay to surround the sand grains and hold them together at the contact points, thus leaving spaces for the gases to pass freely out of the mould.

In the mould provision has to be made for the escape, normally through the mould wall, first of all of the air which is removed when the metal passes into the mould; secondly, of the gases which are generated when the hot metal makes contact with the sand. The gases may be of various orders. There is, first of all, water vapour due to the actual water added to the sand or naturally present in the sand. Some of the combined water may be driven off at about 500 deg. C., and then there may be present certain other gases, such as hydrocarbons, when coal dust, etc., had been added to the sand. Therefore, the mould wall itself, for normal purposes, should be permeable. This is all very well, but if the whole of the mould were very permeable, there would be a tendency, especially with certain sands, to have a bad surface on the

casting. Therefore, a compromise has to be effected. The skin of the mould is made finer by some sort of dressing, such as a facing sand or some sort of paint. The back of the mould is kept open so that the gases which may be, to some extent, prevented from emerging, owing to the fine face, as soon as they get past the face can readily pass through the remainder of the mould. It is necessary to adopt these compromises constantly in dealing with the moulding sands, and especially with synthetic sands.

If a moulding sand is built up starting from clean sand grains, rounded and fairly uniform in size, the surface of the sand grain must be in a suitable condition to take the film bond which is being used. There is a great difference in the ability of clean sand grains to hold any bond, especially a clay bond. If the sand grain has a polished surface the bond will adhere much less than if it has a slightly roughened surface. Still better is a sand grain which, while comparatively clean, has attached to its surface the minutest film of iron oxide. Some of the yellower sands have the minutest film of iron oxide attached to them. It cannot be removed by any scrubbing operation, and sands of that type will readily take an adherent clay bond. When used for synthetic sands, this is a type which will give the most satisfactory results.

American Synthetic Sands

The American foundrymen perhaps did, initially, much more work on synthetic sands than has been done in this country. This is due to the fact that they are much poorer in America in regard to naturally-bonded moulding sands than is the case in this country. They have large resources of soft sandstones which break down into a suitable material for use in the foundry, yielding sands which will easily take, and retain, the film of clay. By taking a suitable sand and adding 5 per cent. of a plastic clay to it, adopting a thorough means of mixing so that the clay is properly spread, a moulding sand is produced which has satisfactory properties from the point of view of strength, permeability and refractoriness.

Refractoriness

The higher the temperature of the metal that is being cast, the more important becomes the question of refractoriness. A pure silica alone—a perfectly clean sand—has a refractoriness of over 1,700 deg. C. When a clay is added to the sand grains, reactions will take place between the clay and the sand which will reduce the fusion point in naturally-bonded sands. There are other impurities to be considered than the clay itself; and it is the presence of these impurities which reduce the fusion point of the sand, and occasionally cause trouble owing to burning-on, etc.

When the logarithm of the grain size is plotted horizontally and the cumulative percentages of the grains vertically, a sand of one grain size only will give an absolutely vertical line, but a mixed sand of varying grain size will show a departure from the vertical line, and a sloping curve will result. In the case of the Birmingham Bunter sand, there is a fair approximation to the ideal sand, as there is quite a good proportion of only two grain sizes. The Belgian yellow is a sand approaching quite close to the ideal sand. Actually, if one plots the grain size of a sand which is a favourite in foundries, it will be found that it does give a curve which is very near to one of the ideal curves; that is to say, that it will contain the major part of its sand grains in one or, at the most, two grain sizes.

Analysis Interpretation

A study of the chemical composition and the grading of the Mansfield medium sand, which is an iron-foundry sand, reveals that it is far from being 100 per cent. silica. The alumina content of about 5 per cent. will be present mainly as a clay. There is some felspar, but it is the hydrated aluminium silicate or the clay substance which gives the sand its plastic character. The sand also contains quite a noticeable proportion of both lime and magnesia. These are fluxes, and if lime be added to a clay or to silica the fusion point is very quickly reduced. A sand with a high proportion of fluxes will not be ideal, say, for use in a steel foundry, but it will be suitable for iron or the non-ferrous metals where the metal temperature is not so high.

The major part of the sand is in two grain sizes, between 1/25th and 0.5 mm. and between 0.1 and 0.25 mm. There is a very small proportion of silt grains; this is important, because it is the silt which has the clogging effect with sand and reduces its permeability. Actually, when sand is continually used in a foundry, the permeability gradually decreases; the sand becomes burned, and is subsequently screened in any way, silt being produced, so that the silt gradually builds up and the permeability is reduced. It is the 13.6 per cent. of clay that is present in this Mansfield sand which makes the sand so strong and gives it some of its excellent characteristics as iron-foundry or brass-foundry sand.

The sands from the Birmingham area are used more especially in non-ferrous metal foundries. They are less refractory than the Mansfield sand. The average sand contains a considerable amount of felspathic impurity. There is practically 3½ per cent. potassium oxide present as felspar, and felspar is an active flux. Again, the sand is practically all of two grain sizes. There is very little silt, and about 3 per cent. of clay grades. With that proportion of clay, of course, the sand will not be so strong as with the much higher proportion in the Mansfield sand.

Belgian Yellow

An actual sand very widely used in steel foundries in pre-war days, and which is still somewhat generally used, is a Belgian yellow sand. The analysis, compared with the analyses of the sands previously mentioned, shows that in the case of this particular sand, a very much smaller proportion of fluxing impurities is present. Lime, magnesia and the alkalis are comparatively low, while 5 per cent. of alumina is present as clay. There is 2½ per cent. of hydrated iron oxide present. This is a really refractory sand. The fusion point is very much higher than in the case of the other examples shown. The mechanical analysis shows that practically all the sand is in two grain sizes; in fact, the major portion of it is in one grain size. A very small proportion of the silt grains is present.

The Belgian yellow moulding sand may be regarded as almost ideal; in fact, formerly, according to the specifications drawn up, an endeavour was made to copy it, at any rate for steel-foundry use. It has the desirable mechanical properties, freedom from the clogging silt, and is within 12 per cent. of bond clay, and the bond clay is very uniformly and tightly spread over all the sand grains. It is known from steel-foundry experience that a sand of this type is more durable than many others with which experiments have been made. The durability is due, to a large extent, to the presence of hydrated iron oxide.

Synthetic Steel-Foundry Sands

An attempt has been made to develop synthetic sands of this type, but it has been difficult to obtain exactly the same characteristics of chemical and mechanical composition by any method of mixing. It was easy enough to add the clay to the sand, and it was possible, with adequate machinery, to get a thorough mixing, and to have the clay completely coating the sand grains. The iron oxide was added as ochre; but it was very difficult to mix the ochre uniformly so as to produce the same type of mixing which nature had evolved in the natural sand. Nevertheless, it was the study of these sands which enabled British steel foundries to be more or less independent of foreign supplies.

A Critical Comparison

Two sands may now be examined a little more critically, including the analysis of the sand itself and the analyses of the various grades in the sand. One is a Bunter sand, and is not a highly refractory sand, as the 3 per cent. of potassium oxide shows the presence of a considerable quantity of felspathic impurity. The silica content of the sand, as a whole, is 86 per cent.

The coarse sand grade, however, shows that it contains 94 per cent. of silica, and that grade, by itself, will be highly refractory, but a consideration of the silt shows it to be very much less refractory. It has 5 per cent. of alkalis, which indicates that a considerable amount of felspathic impurity is present. There is 5.3 per cent. of clay grade, and 19 per cent. of alumina, as against 6 per cent. in the sand as a whole. This is practically a siliceous clay, which, when separated, is a highly plastic material. The mechanical grading of this sand shows there is a desirable freedom from silt, the major part of the sand being in one grain size. There is 5 per cent. of the bond clay.

A similar study of the Belgian yellow moulding sand shows that the coarse sand grains consist of 98 per cent. of silica, or nearly a pure sand, whilst the silt grade indicates a concentration of the impurities; it approaches a clay, but has not yet reached it. There is a clay grade which is much the same composition as a moderately good clay. In the case of Belgian yellow moulding sand, the content of the iron oxide is high in the clay grade, although there is in the sand, as a whole, approximately only 3 per cent. of iron oxide. Taking the clay grades there is 10 per cent. of hydrated iron oxide, which makes that sand a durable one.

Examination of Substitutes

If a comparison be made between the clay grade from the Cornish red sand and pot clay, the former was used as a substitute for Belgian sand during the war period. It was not used extensively, unfortunately, though it was quite a good sand, at any rate for steel-foundry use. The clay grade is about 46 per cent. of silica. In the case of the pot clay, there is 48 per cent. of silica. The sum of the iron and alumina in the clay from the Cornish sand is 33 per cent., as compared with 36 per cent. in the pot clay. So that in the case of a refractory moulding sand there is, as the bond, a clay which is comparable in composition with a highly refractory fireclay. As the refractoriness of this clay grade falls, so does the refractoriness of the sand.

From the angle of the fusion points of four different sands, Worksop red sand is interesting because, while it is fairly refractory, the clay grade has a very much wider softening range than certain other types. In steel-foundry use it has a tendency to burn-on, though it is a very good sand for iron-foundry purposes. It is used to some extent in steel foundries to "let down" some of the more refractory natural sands. Mansfield sand shows a fairly high fusion point, but the clay grade has a somewhat lower softening point, indicating that it is not suitable for use in the steel foundry, although it is useful for iron or non-ferrous metals.

Water Content

The water content of a sand is important in relation to the green strength of the sand; but it is not a constant factor for all sands. In order to develop a maximum strength, one sand will require a great deal more water than another. The quantity varies from 3.8 up to 6 per cent. with some of the Wolverhampton sand. This emphasises the necessity for proper control of the water content not merely in preparing moulding sand, but also in maintaining it. If a heap of sand is left undisturbed in the foundry for a few hours, there will be found to be a marked difference in the water content. It may have decreased as much as 1 per cent. by evapora-

tion, and the characteristics of the sand will have been modified to that extent. The sand may have become decidedly weaker.

Influence of Milling

The actual milling of a naturally-bonded sand has an effect, first of all, on the actual grain size of the sand. Some experimental results with Worksop sand, relating to the grading of the raw sand and transverse and compression strengths, showed that an increase in the time of milling coincided with a gradual increase in strength. There is a rapid increase in transverse and compression strength at first, and then the rate of increase begins to lessen. For such a sand, a period will be selected from the point of view of strength at which the rate of increase in strength begins to fall. Taking a period of 15 minutes, there is a marked increase in strength, and there is very little further change in the grading of the sand. With long periods of milling in the case of Worksop sand, there is a reduction of the silt and a consequent slight increase of permeability. With very prolonged milling the compression strength actually begins to fall. The increase in strength is due to the more uniform distribution of the bond in the sand over the sand grains.

Effect of Milling on Permeability

In the case of the Worksop sand, with 5 per cent. of water, the permeability decreases upon milling, as might be expected, but with prolonged milling it gradually increases. This indicates the importance of selecting, by experiment or trial, a particular milling time and adhering closely to it.

Influence of Silt and Water on Permeability

The effect on permeability of the addition of silt is that, as the silt increases, the permeability rapidly decreases. Permeability is one of the most vital characteristics of a moulding sand for ordinary foundry use, and in the case of mechanised foundries care is taken in regard to de-silting in order to maintain the permeability as constant as possible. Permeability is also varied to some extent with a variation of the water content. With increasing water content, the permeability of fine, medium and coarse sea sands decreases as the water content increases. This emphasises, again, the need for determining, in the case of a particular sand, the optimum proportion of water to obtain the best result from the point of view of both strength and permeability.

Ramming

A factor influencing both permeability and strength is ramming. It does not follow that the ramming density which should give the greatest strength is at the same water content for all sands. A particular water content may, with different sands, require a different type of ramming density in order to attain a similar amount of permeability.

In actual foundry operations a very small difference in the force used in forming a mould may cause a very marked difference in permeability in different parts of a mould. By an increase in the ramming density an increase in strength is effected. The rate of increase of strength is greater at the outset than subsequently, so that if a ramming density of, say, between 1.6 and 1.7 is used, quite an adequate strength is obtained for any normal foundry purpose.

Synthetic Sands

There is a growing use of synthetic sands, especially in the steel foundry and in mechanised iron foundries. Very large resources of suitable high silica sands exist in this country which can be used for synthetic sand production. These sands are widely spread throughout the country. The Leighton Buzzard sand is very refractory, and the Kings Lynn sand is nearly as refractory. If the analyses of these two sands are compared with the analysis of the Belgian silver sand which has been so generally used as a basis for synthetic sand, it will be seen that they compare quite satisfactorily.

Three other sands which are sufficiently refractory to use as a basis for synthetic sands are from Bawtry, Ipswich and Worksop. They are silica sands and not moulding sands. They are very high in silica content, and should be highly valued as refractory sands. If a more efficient bond is combined with them, a moulding sand will be produced which will be satisfactory from the point of view of refractoriness.

Grading of Various Types of Silica Sands

The Belgian sand is over 80 per cent. sand grains of one grade, which makes it a very desirable type of sand. The Kings Lynn sand is better than the Belgian sand from the mechanical point of view, having practically all of the sand grains in one grade. The Leighton Buzzard sand has its grains almost entirely in two grades. By using such a sand as a basis for synthetic sands, and by applying the bond in such a way as to distribute it uniformly over the sand grains, the refractoriness will be retained as well as permeability. If the bond is suitable, there will be sufficient workability; the sand will be sufficiently plastic and strong, both when green and, where necessary, in the dry state. If these are used as a basis for synthetic sands, the required characteristics of refractoriness and permeability will be obtained.

Bonding Clays

A great deal of research work has been carried out in regard to the selection of suitable bonding clays for the making up of synthetic sands. There is no doubt that the most satisfactory of the bond clays is the material usually known as bentonite, which, unfortunately, has to be imported. Bentonite is a very highly colloidal clay, and its plasticity is extremely high. A very small proportion of it can be easily spread over sand grains, thus producing a very high plasticity and a very high degree of strength. Nevertheless, there are many other clays which can be used, and quite a number of satisfactory ones can be found in this country.

The essential point in the preparation of a clay for use in a synthetic sand mixture is to make sure that it is finely ground. It must be very finely divided indeed. In the case of some proprietary clays which are used for synthetic sand production, they are clays which have been ground in a colloid mill which reduces the clay to a grain size of the order of the grain size in the naturally-bonded sands. A clay of that type will spread very rapidly, quite a small proportion of it can be used, and it will retain, in the synthetic sand, the desired properties of refractoriness, permeability and strength.

A very interesting way of adding a clay to high silica sand is actually as a slip; what, in the laboratory, is termed a de-flocculated slip. Traces of alkali are added to the slip in order transform the colloids in the clay into the sol condition. A very dense slip can be made, and when the clay is added to the silica sand in the slip form, it very easily distributes itself over the sand grains. There are some producers of synthetic sands who normally add the clay as a slip, but when it is added as a powder, it is essential that the powder shall be extremely fine.

Investigations which have been carried out during the past 20 years have placed us in possession of much information respecting the fundamental properties of moulding sands. Those investigations make it quite evident that it is very important to maintain adequate control of the sands in actual foundry practice.

IN ORDER TO COPE with the increasing demand for stand-by lighting plant for use in case of damage to the mains from air raids, R. A. Lister & Company, Limited, of Dursley, have opened a special A.R.P. Department in London.

Rust Preventive for Cupolas

BY H. R. THOMAS.

In many foundries cupolas are installed in the moulding shop and are thus preserved from the ravages of the weather. A large number of cupolas, however, are more often than not placed outside the shop adjacent to one of the foundry walls. They are thus exposed to wind and rain and unless treated with some preparation are usually rusty.

While detracting from the appearance of the foundry, this is not the worst effect of rust, as the periodical scaling resulting from it causes the gradual thinning of the cupola shell, with attendant troubles. The question "What is the best preventive to use on such structures as cupolas?" is often asked. The coating must be able to withstand the action of rain and also the heat from the cupola. There are many preparations on the market which are excellent if applied on a new cupola, but which are of only indifferent success when used on structures that have been attacked by rust to any great extent. Such a cupola was seen by the writer a short time ago which had been coated with an aluminium paint, without any appreciable effects, as the paint was soon thrown off. It had then been tarred, a treatment which was also entirely useless, as the tar burned off while the cupola was working. This cupola is now well preserved and the preparation ultimately used was fairly cheap.

After removing with a wire brush all the rust and scale adhering to the shell of this cupola, it was coated with a mixture of old machine oil and a cheap grade of mineral blacking. The machine oil was such as is often found accumulating in engineering works—oil which had been used and was of no further use for its original purpose.

While discarded oil alone is useful as a preservative, an addition of blacking to it was advantageous, in that when the preparation was well rubbed in and the oil had evaporated, the blacking formed a face on the shell that was impervious to water. After a preliminary coat, another was applied, and lasted a considerable while.

This cheap mixture of oil and blacking would no doubt be very useful to other small jobbing foundries in various parts of the country.

Imported Foundry Machinery

EXEMPTION FROM DUTY

The Import Duties Advisory Committee announce that, in accordance with the provisions of Section 10 of the Finance Act, 1932, authorising, in certain circumstances, the exemption of particular consignments of machinery, being machinery of a kind not for the time being procurable in the United Kingdom, from the whole or part of the duties chargeable under the Import Duties Act, 1932, they have recommended, and the Treasury have approved, that the Section shall apply to the following additional classes of machinery, *viz.*, blast furnace, smelting, metal refining and foundry machinery.

Application may be made by, or on behalf of, a firm purchasing machinery for their own use, or by an importer having the sole agency for the sale of a particular machine in this country. The appropriate forms of application may be obtained from the Secretary, Import Duties Advisory Committee, Shell-Mex House, Strand, London, W.C.2.

Pipes for Yorkshire Gas Grid

The United Kingdom Gas Corporation, Limited, which controls over 70 gas undertakings in Great Britain, has placed an order for 75 miles of spun-iron pipes (in several diameters up to 18 in.) with the Stanton Ironworks Company, Limited. These pipes will be used for the new Yorkshire gas grid, and many miles of them will carry gas at high pressure. All the pipes will have Stanton-Wilson self-adjusting joints.

CLEAN IRON
SAVES COKE IN THE CUPOLA

The cleaner iron given by Workington Machine Cast Process (free from sand fused to the surface) saves fuel in the cupola. A foundry which used Machine Cast Iron reports the following results:

- **Coke consumption decreased by 20%**
- **Slag from the cupola reduced by 45%**
- **Limestone charged reduced by 50%**
- **Quantity of iron melted increased by 24%**
- **Hanging eliminated completely.**
- **Castings cleaner.**
- **Metal composition more regular.**
- **Longer life of cupola lining.**

THE UNITED STEEL COMPANIES LTD

Write to The Publicity Department, The United Steel Companies Limited, 17, Westbourne Road, Sheffield, 10, for Brochure "Machine Cast Iron."

WORKINGTON
MACHINE CAST IRONS

WORKINGTON IRON & STEEL COMPANY · WORKINGTON · CUMBERLAND

BRANCH OF THE UNITED STEEL COMPANIES LIMITED

® W.33R

West Yorkshire Foundrymen Make Presentation to Mr. J. Hepworth

OPENING MEETING IN BRADFORD

The opening meeting of the new winter session of the West Riding of Yorkshire Branch of the Institute of British Foundrymen took place on October 8, at Bradford Technical College, when Mr. A. S. Worcester presided over a good attendance. For a short period Mr. Joseph Hepworth, M.P., the President of the Institute, was able to be present, and he was presented by the Branch with a silver cup as a small memento of his part in the promotion and preparations for the Institute's Annual Convention which was held at Bradford in June last—the first national gathering of the body in the West Riding Branch area.

In addition to this presentation, the Conference Committee also presented to the West Riding Branch a handsome and substantial chairman's gavel and block, made in black ebony and containing small silver shields bearing the name of the Branch-President and all the Past-Presidents, and with ample space for many more shields for years to come.

In accordance with the custom for some years past, the members assembled at the College Refectory for high tea, as guests of the Branch-President (Mr. Worcester). The presentations, and Mr. Worcester's Presidential Address, were features of this gathering, prior to the party moving over to the College proper for the evening's normal business.

After tea the thanks of the members to Mr. Worcester for his hospitality were voiced by MR. F. K. NEATH (Past-President of the Branch), seconded by MR. H. A. MACCOLL (Junior Vice-President).

MR. H. FORREST (Immediate Past-President) made the formal presentation of the gavel and block, which Mr. Worcester accepted on behalf of the Branch.

Mr. Forrest, as Chairman of the local Conference Committee—supported by the Branch-President—then made the presentation to Mr. Hepworth. Mr. Forrest said the members of the West Riding Branch were extremely proud of the fact that they had so distinguished a member of their own Branch, and one of their own Past-Presidents, as head of the Institute nationally. He was the first West Riding Branch member to occupy that high and important office, and his fellow members were quite certain he would uphold the great traditions of the Institute. The Conference Committee wished not only to make this little presentation as a mark of Mr. Hepworth's high office, but of their personal esteem and their thanks to a man occupied in so many directions for his part in helping to make the Bradford conference the success it had been.

MR. HEPWORTH, thanking the members, said his own part in the preparations for the Conference had been very modest by comparison with that of Mr. Forrest and his colleagues on the Conference Committee. He believed they could pride themselves on having surprised the visitors by the success of the local arrangements, and he felt great credit was due to the members of the West Riding Branch as a whole for the hearty and ready manner in which they had all co-operated. Mr. Hepworth concluded by wishing Mr. Worcester a year of successful chairmanship, and expressing a conviction that with a man of Mr. Worcester's experience in the industry, not to mention previous experience in the Presidency of the West Riding Branch, they could look forward to a very successful session.

PRESIDENT'S ADDRESS

MR. A. S. WORCESTER, addressing the meeting, said he was not quite a stranger in the chair of the West Riding Branch, having occupied it for two previous years a while ago. Anything he had to say in the way of an extended Presidential Address he had said before, and he did not intend to do anything more than make a few observations about the coming session.

Nobody could gainsay the fact, said Mr. Worcester, that the foundry industry had not yet attained the position it ought to occupy. Probably the Institute was the best means of putting their house in order. The ramifications of the Institute's Technical Committee were very wide, giving the members access to all developments in the industry. The two West Yorkshire Branch members of Council, Mr. F. K. Neath and Mr. S. Carter, would maintain the prestige of the Branch. The opportunity to members to bring their masterpieces or their failures to be surveyed and discussed by other members, with an exchange of experiences and difficulties met or overcome, must be for the ultimate good of the industry as well as the members individually.

Conference Committee Thanked

Turning to the affairs of the Branch, Mr. Worcester said the syllabus once again embraced a wide variety of subjects for discussion, interspersed with interesting works visits and social functions. Since the end of the last session, history had been made in the Branch by the West Riding members entertaining the Institute Conference for the first time. He felt that all who had attended the gathering could testify to the fact that the selection of men for the local Conference Committee had been a very excellent choice. They had been fortunate in having such a prominent and influential public man as Mr. Hepworth, M.P., to take up the duties of President of the Institute. All the members of the Conference Committee had pulled their weight, but it was making no invidious distinctions to mention specially Mr. Forrest, the chairman, Mr. W. G. Thornton, the treasurer, and Mr. S. W. Wise, the secretary, who had all put in a tremendous amount of work. Mr. Worcester said he would like to take the opportunity now of extending thanks to those gentlemen, who had shouldered very big responsibilities. He felt sure the Conference had brought a big fillip to interest in the Institute and in the Branch among members of the industry in the West Riding area. The membership, he felt sure, would register an increase, and he hoped and believed the lively interest of the members generally would long continue.

Mr. Worcester was thanked for his address on the motion of MR. S. CARTER (Senior Vice-President), seconded by MR. R. D. WELFORD (Past-President).

MR. FORREST, on behalf of the Branch, voiced thanks to Mr. Welford for a gift of twelve books to the Branch Technical Library; and to Mr. H. F. Ogden ("F.T.J." correspondent) for articles and sub-editing help in the preparation of the Conference Handbook.

Joint Committee on Sand Testing

On the initiative of the British Cast Iron Research Association's Moulding Sands and Refractories Sub-Committee, a joint committee on sand testing has been formed of representatives of four interested bodies. The Iron and Steel Institute has nominated Dr. R. J. Sarjant and Mr. T. R. Walker; the Institute of British Foundrymen, Mr. J. J. Sheehan and Mr. A. Tipper; the British Non-Ferrous Metals Research Association, Mr. F. Hudson and Mr. T. F. Pearson; and the B.C.I.R.A., Dr. J. G. A. Skerl and Mr. W. B. Parkes. These, with the probable addition of Mr. W. J. Rees, will constitute the Joint Committee.

(Continued from next column.)

of both Institutes on Wednesday, October 26, after the meeting up till 7 p.m. The President and Council will be pleased to welcome members.

Autumn Meeting of the Institute of Metals

The Autumn Meeting of the Institute of Metals will be held at the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W.1, on Thursday, October 27, at 10 a.m. and at 2.30 p.m.

The Iron and Steel Institute

AUTUMN MEETING IN LONDON

The Council of the Iron and Steel Institute confirm that, in accordance with previous announcements, the joint Autumn Meeting of the Iron and Steel Institute and the Institute of Metals in New York on October 3 and 4, 1938, and the tours in Canada and the United States of America, have been cancelled.

The Autumn Meeting of the Iron and Steel Institute will be held, by kind permission, in the Lecture Theatre at the Institution of Civil Engineers, Great George Street, Westminster, S.W.1, on Wednesday, October 26, 1938, at 10 a.m. and at 2.30 p.m.

The Institute of British Foundrymen has accepted an invitation for members to take part in the discussion on the Third Report of the Steel Castings Research Committee which will be presented during the afternoon session.

Programme

The programme of the meeting is given below:

Morning Session.—10 a.m. Ballot for the election of new Members and Associates and other formal business. Presentation of the following Papers for discussion:—

(1) Paper No. 7, W. M. Farnsworth and E. R. Johnson, "American Electric-Furnace Practice." Paper No. 5, D. F. Campbell, "Electric Furnaces in European Steelworks." The above two Papers will be discussed jointly.

(2) Paper No. 15, C. Sykes and H. Evans, "Specific-Heat/Temperature Curves of Commercially Pure Iron and Certain Plain Carbon Steels."

(3) Paper No. 3, Quincy Bent, "Modern Rolling-Mill Practice in America, exclusive of Continuous Strip and Sheet Mills." Paper No. 6, D. Eppelsheimer, "The Development of Continuous Strip Mills." The above two Papers will be discussed jointly.

Afternoon Session.—2.30 p.m. Presentation for discussion of Special Report No. 23, "Third Report of the Steel Castings Research Committee," being a Report by a Joint Committee of the Iron and Steel Institute and the British Iron and Steel Federation, reporting to the Iron and Steel Industrial Research Council. The Institute of British Foundrymen, as intimated above, have accepted an invitation to take part in the discussion.

(4) General Presentation of the Report (no discussion).

(5) Section V.—Presentation and discussion of the First Report of the Moulding Materials Sub-Committee.

(6) Section IV.—"The Strength and Ductility of Cast Steel during Cooling from the Liquid State in Sand Moulds, Part II," by H. F. Hall, B.Sc., A.M.I.Mech.E.

(7) Section III.—"Copper-Steel Castings," by Martin Alexander, B.Sc.

(8) Section II.—Discussion on "The Fluidity of Iron-Carbon and Other Iron Alloys."

(*a*) Presentation of Part A, "The Fluidity of Alloy Steel," by Prof. J. H. Andrew, D.Sc., G. T. C. Bottomley, B.Met., W. R. Maddocks, Ph.D., B.Sc., and R. T. Percival, B.Met.

(*b*) Presentation of Part B, "The Ruff Fluidity Test."

1.—Introductory comments on the Ruff Test.

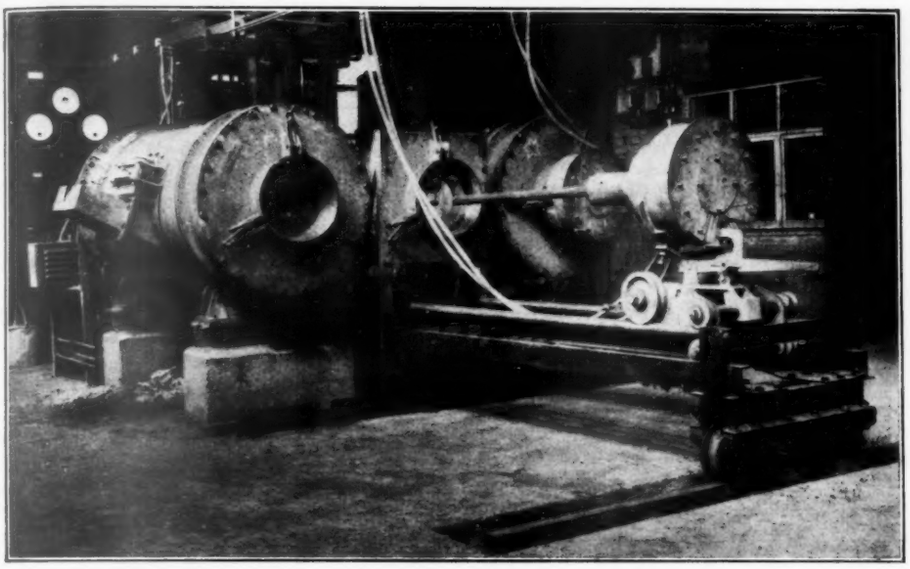
2.—"Works Results Using the Ruff Fluidity Test," by T. R. Walker, M.A., F.I.C.

3.—"Fluidity-Temperature Relations of Cast Steels of Various Compositions," by R. J. Sarjant, D.Sc., and T. H. Middleham.

Inspection of Offices

The new offices of the Institute and of the Institute of Metals and the Joint Library at 4, Grosvenor Gardens, Westminster, London, S.W.1, will be open for informal inspection by members

(Continued in previous column.)



EFCO Rocking Resistor Furnaces

Photograph by courtesy of Messrs James & Co. Ltd., Halesowen

We specialise in the supply of all kinds of electric furnace plant and can therefore give unbiased advice on the correct type of furnace for any class of work

EFCO

Lindum

THE EFCO RANGE OF ELECTRIC FURNACES FOR MELTING AND HEAT TREATMENT OF IRON AND STEEL INCLUDES:

AJAX NORTHRUP HIGH FREQUENCY FURNACES ● HEROULT ARC FURNACES ● ROCKING ARC FURNACES ● ROCKING RESISTOR FURNACES ● EXPERIMENTAL FURNACES FOR RESEARCH WORK ● RESISTANCE FURNACES OF ALL TYPES FOR ANNEALING, TEMPERING AND HARDENING

ELECTRIC FURNACE COMPANY LTD
17 VICTORIA STREET, LONDON, S.W.1
PIONEERS and SPECIALISTS in COMPLETE ELECTRIC MELTING EQUIPMENTS

WARNER Special PIG IRONS

- Warner C.B.R. and Low Carbon Cylinder (FOR CYLINDERS, ROLLS, ENGINEERING CASTINGS, ETC.)
- Low Carbon Malleable (FOR MALLEABLE CASTINGS OF ALL DESCRIPTIONS)

Supplied to any specification between limits of 2·00 and 3·50% Carbon and ·50% and 3·50% Silicon

● ACTUAL ANALYSIS CERTIFICATES ARE AVAILABLE WITH EACH DELIVERY

● **Typical Cylinder Pig Iron Specification**

TOTAL CARBON	2·70%
SILICON	1·80%
MANGANESE	·90%
SULPHUR	·06%
PHOSPHORUS	·40%

● **Typical Malleable Pig Iron Specification**

TOTAL CARBON	2·60%
SILICON	·75%
MANGANESE	·50%
SULPHUR	·05%
PHOSPHORUS	·06%

WARNER & CO. LTD. MIDDLESBROUGH

Presidential Address he had said before, and he

Thursday, October 27, at 10 a.m. and at 2.30 p.m.

(Continued in previous column.)

The Week's News in Brief

Trade Talk

FORGES DE CINEY, the Belgian foundries, report a net profit of 1,213,347 fcs. for the year to June 30 last, against 1,827,768 fcs. in 1936-37.

THE BURNLEY IRON WORKS COMPANY, LIMITED, is being wound up voluntarily. Mr. J. P. Wood, 7, Grimshaw Street, Burnley, is the liquidator.

THE EIGHTH ANNUAL BALL of the Birmingham branch of the Royal Metal Trades' Pension and Benevolent Society is to be held at the Grand Hotel on October 27

SANDERSON BROS. & NEWBOULD, LIMITED, steel manufacturers, Sheffield, have notified satisfaction in full of a trust deed securing £100,000 first mortgage debentures.

WHITE'S MARINE ENGINEERING COMPANY, LIMITED, Hebburn-on-Tyne, have received the contract for the supply of engines for two boom defence vessels ordered by the Admiralty from the Blyth Dry Docks & Shipbuilding Company, Limited.

A LECTURE on welding repairs, accompanied by about 60 excellent lantern slides, has been prepared by Barimar, Limited, 14/18, Lamb's Conduit Street, London, W.C.1, and is available on loan, without charge, to technical schools and colleges, engineering societies and similar institutions.

THE DEPARTMENT OF OVERSEAS TRADE announce that free passport visas will be given, where these are required, to all *bona fide* overseas buyers visiting the 1939 British Industries Fair, which opens in London and Birmingham on February 20. The visas, which can be obtained on application to the nearest British Consular Officer, are valid for three months from the date of issue.

A. & W. SMITH & COMPANY, LIMITED, sugar-machinery manufacturers, of Glasgow, who in March last completed a large sugar-cane crushing plant to the order of the West Indies Sugar Company, for the modern sugar factory at present being erected in Jamaica, have secured the order for a duplicate plant. This installation is being built to the order of Caroni, Limited, for a new cane sugar factory which is to be erected in the island of Trinidad, British West Indies. The ultimate capacity of this plant will be 2,500 tons of cane per day.

A COURSE of six lectures on industrial law has been arranged by the Industrial Welfare Society, including: The Contract of Employment, the Truck Acts, the Factories Act, 1937, National Health and Unemployment Insurance, and the law relating to Welfare Schemes. These lectures will be given at 14, Hobart Place, London, S.W.1, on Wednesday evenings at 6.30 p.m., beginning November 9, 1938. The lecturer will be Mr. H. Samuels, M.A., Barrister-at-Law. The fee for the course of six lectures will be 30s., with a reduction for members of the Society to 21s.

AT A REGIONAL CONFERENCE of the National Safety First Association at Birmingham, on October 5, a Paper was read by Mr. A. P. Young, works manager of the British Thomson-Houston Company, Limited, Rugby, pointing out the necessity of eliminating accidents to young persons by planning on the part of industrial managements, co-operation with organisations concerned with safety, and education of the young worker. His talk was accompanied by a film which the B.T.-H. Company shows to all its young workers, and which was commended, both in a foreword on the screen and in person at the conference, by Sir Duncan Wilson, Chief Inspector of Factories. It was, he said, a film the principle of which he would like to see copied by other large firms.

MR. ALLAN J. GRANT, managing director of Thos. Firth & John Brown, Limited, in a speech following his installation as Master Cutler at Sheffield last week, said that steel production in the United Kingdom for the first half of 1938 was some 6½ per cent. below the corresponding period of 1937, but the Sheffield district output was less by only a fraction of 1 per cent., though some falling off in activity was now evident. There was, however, no reason why it should develop into so severe a depression as the last one, as economic conditions were different and the steel industry was now assisted by a flexible tariff. Moreover, the agreement covering exports between the British Iron and Steel Federation and the Cartel had recently been extended to provide for collaboration with the American industry. The steel industry was fortunate therefore in enjoying the benefits of co-operation with its principal competitors in the development of export markets. The Minister of Health's instruction to local authorities to accelerate as far as possible their housing programmes as the housing activity by private enterprise tended to fall away, was to be welcomed as affording hope for the future of a greater degree of stability in constructional engineering, an industry whose severe fluctuations in activity had, in the past, been reflected by wide variations in demands on the heavy steel makers. One of the most effective means, however, of combating a recession in the demand for steel was the wise development of new uses, and here Sheffield took a prominent part. The developments in high-grade alloy steels were almost confined to this particular district, and by the efforts of the research departments of the University and the larger private firms, steels possessing new properties of strength and heat and corrosion resistance were being very rapidly developed.

Personal

GIFTS FROM DIRECTORS and employees have been handed to Mr. David Ogg, on his retirement from the Anderson-Grice Engineering Works, Carnoustie. He was associated with the foundry for over 52 years.

MR. JOHN CAMERON, SENIOR (Past-President of the Institute of British Foundrymen), who was taken ill during his visit to Poland whilst attending the International Foundry Congress, has now returned to England. We are pleased to learn that he is making good progress towards recovery of his health.

SIR RONALD W. MATTHEWS has been appointed chairman of the London & North Eastern Railway Company in succession to Mr. William Whitelaw. Sir Ronald, who joined the board in 1929, is a director of 14 other companies, of six of which he is chairman. He is deputy-chairman of General Refractories, Limited, chairman of J. Grayson Lowood & Company, Limited, and vice-chairman of Turton Bros. & Matthews, Limited. His directorships include those of the Glenboig Union Fire-Clay Company, Limited, International Diatomite Company, Limited, the Brush Electrical Engineering Company, Limited, and J. & G. Wells, Limited.

PROF. R. H. FOWLER, F.R.S., at his own request for reasons of health, has been released by the Lord President of the Council from the engagement to assume the Directorship of the National Physical Laboratory on October 1, in succession to Dr. W. L. Bragg. To the vacancy thus created, the Lord President has appointed Dr. C. G. Darwin, F.R.S., Master of Christ's College, Cambridge. For the period until Dr. Darwin can assume his duties, the Lord President has decided that the office of Director shall be held by Sir Frank Smith, Secretary of the Department of Scientific and Industrial Research.

Wills

SENIOR, G. E., of Sheffield, a former joint managing director of George Senior & Sons, Limited	£99,362
HOLT, W. H., managing director of Holt, Siron & Company, Limited, brass and die casters, Birmingham	£4,788
HORDERN, A. W., of Kenilworth, Warwick, late managing director of Hordern, Mason & Edwards, Limited, makers of power presses, of Birmingham	£61,107

Obituary

MR. WILLIAM TIMBRELL, founder of the machine tool and engineering firm of Timbrell & Wright, Birmingham, died recently.

SIR HAROLD BEAUCHAMP, chairman of Imperial Chemical Industries (N.Z.), Limited, and a director of Imperial Chemical Industries of Australia, Limited, died at Wellington, New Zealand, on October 4, at the age of 79.

MR. AMOS SMITH, who in 1930 retired from the position of foreman at the Hope Foundry of Robert Hall & Sons (Bury), Limited, with whom he had been in employment for 55 years, died on October 7, following a motor-car accident. He was 74 years old.

Zinc Supplies and Prices

The Import Duties Advisory Committee announce that they have under consideration proposals for the variation of the existing arrangements governing supplies and prices of Empire zinc and the import duty on foreign zinc, and in particular for an increase in the present rate of duty.

Any representations which interested parties may desire to make in regard to this matter should be addressed to the Secretary, Import Duties Advisory Committee, Shell-Mex House, Strand, London, W.C.2, not later than October 21.

New Companies

(From the Register compiled by Jordan & Sons, Limited, Company Registration Agents, 116 to 118, Chancery Lane, London, W.C.2.)

Wolverhampton Iron Founders, Limited, Berrington Chambers, 93, Tettenhall Road, Wolverhampton. —Capital £1,000.

Baxter & Impey, Limited, 55, Pershore Street, Birmingham.—Capital £500. Electrical, hydraulic and mechanical engineers, etc. Directors: W. M. Baxter and L. J. F. Austin.

Company Reports

British Oxygen Company, Limited.—Interim dividend on the ordinary stock of 7 per cent.

Manganese Bronze & Brass Company, Limited.—Interim dividend of 3d. per 1s. ordinary share.

Churchill Machine Tool Company, Limited.—Interim dividend on the ordinary stock at the rate of 20 per cent. for the year ending December 31.

Contracts Open

Pembrey, October 17.—Pumping equipment, comprising pumps, motors, Diesel engine, pipework and valves, for Pembrey Royal Ordnance Factory, for the Commissioners of Works, &c. Room 65D, Third Floor, H.M. Office of Works, London, S.W.1. (Fee £1, returnable.)

Forthcoming Events

OCTOBER 19.

Institute of Welding (London Branch):—Presidential address by Sir William J. Larke, at Institution of Mechanical Engineers, Storey's Gate, London, S.W.1, at 6.30 p.m.

OCTOBER 20.

Royal Aeronautical Society:—"Use of Light Alloys in Aircraft Construction," Paper by M. R. Le Cœuvre, at Institution of Mechanical Engineers, Storey's Gate, London, S.W.1, at 6.30 p.m.

Institute of British Foundrymen

OCTOBER 14.

Falkirk Section:—Social and smoking concert, at Argyll Restaurant, Falkirk, at 7.30 p.m.

OCTOBER 15.

Falkirk Section:—"Technical Committee and Its Work." Paper by Dr. J. W. Donaldson, at Temperance Café, Lint Riggs, Falkirk, at 6 p.m.

OCTOBER 17.

Lincolnshire Section:—Presidential address, by G. L. Harbach, at Lincoln Technical College, at 6.45 p.m.

OCTOBER 20.

East Anglian Section:—Works visit to E. R. & F. Turner, Limited, Ipswich; Report of Cast Iron Sub-Committee; Presidential address, and social evening, at Central Library, Ipswich, at 7 p.m.

OCTOBER 21.

Lancashire Branch (Junior Section):—Annual general meeting; Presidential address; "Green-Sand Moulding and Skin-Dried Moulds," Paper by A. Sutcliffe, at College of Technology, Sackville Street, Manchester, at 7.15 p.m.

Middlesbrough Branch:—Report of Cast Iron Sub-Committee on the Properties of Grey Cast Iron, presented by E. B. Ellis, at Cleveland Scientific and Technical Institution, Middlesbrough, at 7.45 p.m.

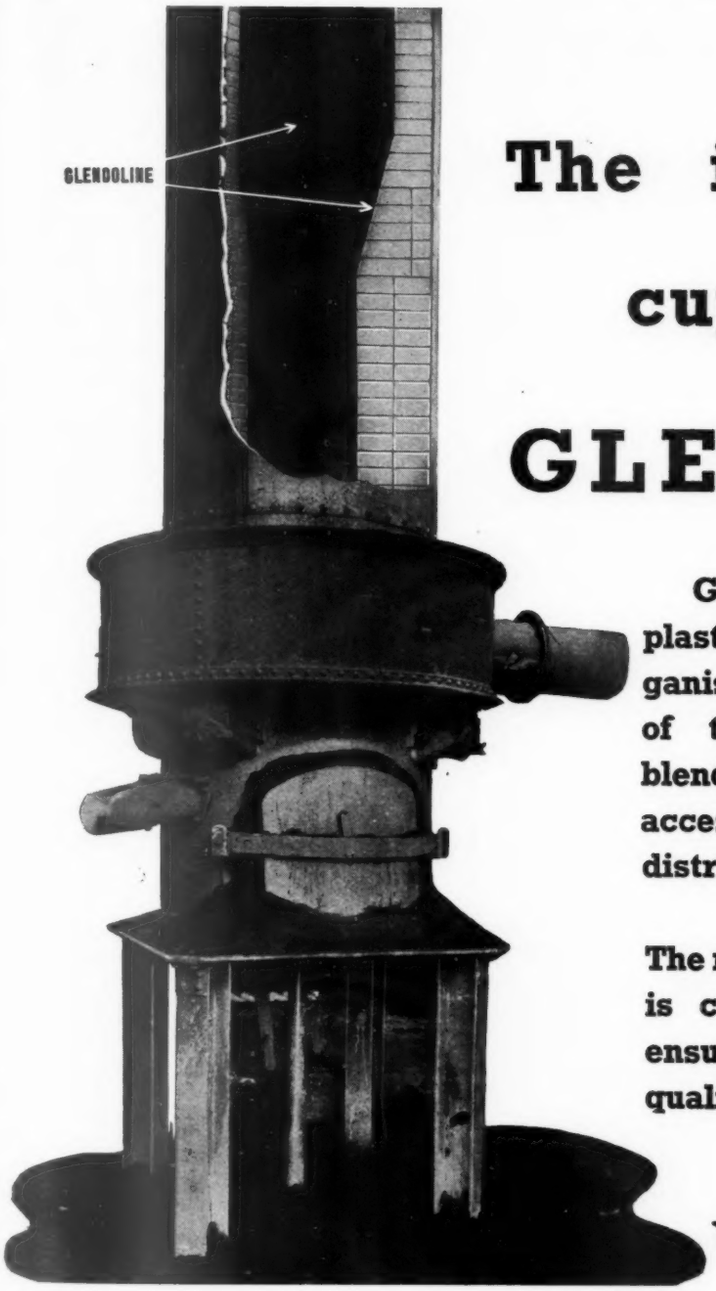
OCTOBER 22.

East Midlands Branch:—Visit to British Thomson-Houston Company's works, Rugby. "Recent Research on Foundry Coke," Paper by H. E. Blaydon.

The Institute of Vitreous Enamellers

OCTOBER 20.

Midland Section:—Annual supper and informal discussion at Imperial Hotel, Birmingham, at 7.30 p.m.



★ This photograph of a cupola, shows a portion of the lining and the positions where Glendoline is recommended for lining and patching.

The ideal cupola lining...

GLENDOLINE

Glendoline is a carefully prepared plastic refractory, comprising ganister stone from a selected bed of the famous Sheffield quality, blended with clay from a seam accessible in the Northamptonshire district.

The mixing and grading of Glendoline is controlled to a definite formula, ensuring dependable and uniform quality.

★ EXTREMELY PLASTIC

★ HIGHLY REFRACTORY

★ GREAT MECHANICAL STRENGTH

Please write for full information and descriptive leaflet to :—

GENERAL REFRACTORIES Ltd.

Telephone : *Sheffield* 31113 (6 *lines*). **GENEFAX HOUSE, SHEFFIELD** *Telegrams :* *"Genefax, Sheffield."*

Raw Material Markets

Increased activity at some of the consuming works has resulted in a speedier reduction of stocks of foundry pig-iron, but buyers are still refraining from entering into new contracts for substantial tonnages, as prices come up for revision before the end of the year, and it is hoped that lower quotations will rule for deliveries in 1939. Some users are much behind schedule in liquidating their existing contracts, and will not have need to negotiate further for some time to come.

Pig-Iron

MIDDLESBROUGH.—Business continues to be within narrow compass in this area, and consumers who have to buy are restricting their purchases to small parcels for early delivery. In view of the prospects of reduced prices next year, it is certain that there will be no change in trade until after December 31. The system whereby a rebate of 5s. per ton is allowed to consumers who agree not to purchase supplies from the Continent has had satisfactory results, but the stocks of foreign material have only recently been used up, as many users bought heavily before the rebate came into force. Prices are based on No. 3 Cleveland G.M.B. foundry iron at 109s. per ton, delivered Middlesbrough or Falkirk.

The current production of hematite is now little in excess of requirements; this does not indicate any expansion in the demand, but merely that outputs have been steadily reduced to meet existing circumstances. There has been some slight increase in the call for contract deliveries, but most consumers are still considerably in arrear in this respect. Deliveries on the North-East Coast are priced at 132s. 6d., Sheffield 138s., Manchester 140s. 6d., and Birmingham 143s. 6d., less 5s. rebate.

LANCASHIRE.—A rather brighter tone prevails on the market in this district, but still the demand is unsatisfactory and consumers are not taking up supplies very regularly. There are exceptions to this, and especially among the machine-tool trade and the heavy electrical engineering concerns. Where contracts have expired, consumers are negotiating for small parcels to tide them over the period until revised prices come into force after the turn of the year. Armament orders are helping to keep some manufacturers better employed than they would otherwise have been; the textile machinists' order-books are aided by Government orders, and without them they would be very badly situated. The light-castings makers and some of the jobbing founders are now experiencing an increase in trade and are calling for additional iron under contracts.

MIDLANDS.—Although there is still little business being done in high-phosphorus iron, good tonnages of low-phosphorus pig are moving into consumption. The heavy engineering, motor and engine trades are particularly heavy users of the latter, while there has been an increase in the demand from the jobbing trade. There is no control on this type of iron, and prices vary according to the source of supply. The minimum is £5 10s. With many of the light-castings foundries working only three days a week and other consumers also badly situated for work, the demand for high-phosphorus iron remains at a low level. There are indications that there will shortly be an increase in trade, as certain users are anticipating more active conditions during the autumn. Little change can be reported in hematite, and many consumers are still much behind in taking up their contract deliveries. Although busier conditions are expected to be experienced, it will be a considerable time before new orders are placed in this section.

SCOTLAND.—During the crisis many consumers took up larger deliveries under contracts, but now that the trouble has passed, there has been a return to quiet conditions. Activity among the light-castings trade continues to be rather unsatisfactory, but there are hopes that an improvement will mature later in the year. No. 1 foundry iron is quoted at 120s. 6d., f.o.t. furnaces, with No. 3 at 2s. 6d. per ton less. With the steelworks operating at well under normal capacity, the demand for hematite is naturally restricted. The seriousness of the international situation recently induced a spurt in buying, but this has now fallen away. Hematite mixed numbers are quoted at 133s., with Scottish basic at 107s. 6d. and English and Indian basic at 100s., less 5s. rebate, delivered works. With regard to Indian basic, there have been no consignments for a considerable time.

Coke

Business is on a good scale in the foundry-coke market, and consumers are now negotiating for heavy tonnages. The crisis stimulated the market, but users are still making inquiries. Many consumers are intent on building up stocks to a good level as a precaution against delays in deliveries when the inclement weather makes transport difficult.

Steel

Business in the steel market is on a restricted scale, but some encouragement is derived from the fact that in some sections of the industry the stocks have been materially reduced, and that the volume of inquiry shows signs of expanding. In the semi-finished steel section, also, stocks have been materially reduced and there is a tendency for the demand for the British product to broaden. Some of the consuming works, however, are not well off for orders and are maintaining a cautious attitude towards fresh commitments. Irregular conditions continue to prevail in the finished steel market, and while the heavy-steel works still have a fair tonnage of orders upon their books, comparatively little new business is reaching them. As a result operations are well below capacity.

Scrap

There has been a further improvement in the iron and steel scrap trade in most districts. Iron scrap, especially, has been in better demand. As yet, trade is still confined to small parcels for early delivery, but there are indications that there will shortly be a heavier demand forthcoming. Stocks at the merchants' depôts are very substantial in most instances, and will not be materially reduced until consumers' stocks have been used up. No doubt, business in steel scrap has been held up by the lack of information regarding future quotations.

Metals

Strong conditions have ruled on the base metal markets during the past week, and quotations have rallied accordingly. The price of tin has passed the £200 mark, and thus, for the first time since the scheme was started, has crossed the lower price limit envisaged in the buffer pool scheme.

Copper.—On Monday the copper-producing companies in the restriction scheme decided to raise their output from 95 per cent. to 105 per cent. of the agreed basic tonnages as from Saturday next. The increase represents an additional production of about 6,000 tons a month. No doubt, the decision of the producers was influenced by the stronger statistical position of copper; stocks have fallen from 554,000 tons to 495,000 tons since May, and the trend is still downwards.

Business has been quite bright recently, and the September statistics are expected to show that stocks are considerably lower. The demand on industrial account has shown a welcome increase, although buying on trade account is still far from satisfactory.

Metal Exchange quotations were as follow :—

Cash.—Thursday, £44 to £44 2s. 6d.; Friday, £44 3s. 9d. to £44 6s. 3d.; Monday, £45 5s. to £45 6s. 3d.; Tuesday, £46 2s. 6d. to £46 3s. 9d.; Wednesday, £45 18s. 9d. to £46.

Three Months.—Thursday, £44 3s. 9d. to £44 5s.; Friday, £44 8s. 9d. to £44 10s.; Monday, £45 8s. 9d. to £45 10s.; Tuesday, £46 5s. to £46 7s. 6d.; Wednesday, £46 3s. 9d. to £46 5s.

Tin.—The tone of this market has been strong during the past week, and business has been active. On the Continent, Germany continues to take up very heavy tonnages, and there seems to be no limit to her requirements. General industrial conditions in the United States are better, and the demand for tin has reacted accordingly.

Official quotations were as follow :—

Cash.—Thursday, £202 5s. to £202 15s.; Friday, £204 to £204 5s.; Monday, £207 10s. to £208; Tuesday, £206 5s. to £206 10s.; Wednesday, £205 5s to £205 10s.

Three Months.—Thursday, £203 15s. to £204; Friday, £205 5s. to £205 10s.; Monday, £209 to £209 5s.; Tuesday, £207 5s. to £207 10s.; Wednesday, £206 10s. to £206 15s.

Spelter.—The Import Duties Advisory Committee has announced that it has under consideration proposals for the variation of the existing arrangements governing supplies and prices of Empire zinc and the import duty on foreign zinc, and in particular for an increase in the present rate of duty. Nothing further is known at present, but it will be recalled that when the last revision in the zinc duties was made, the Committee suggested that it would not hesitate to provide additional protection to the home zinc industry. Further rumours concerning a revival of the Zinc Cartel have been in circulation recently. There have been many false rumours in the past, but this time it would seem that determined efforts are being made and that some results may be expected. The spelter market has been active during the week, and some quite good tonnages have changed hands.

Daily market prices :—

Ordinary.—Thursday, £14 12s. 6d.; Friday, £14 13s. 9d.; Monday, £15; Tuesday, £14 17s. 6d.; Wednesday, £14 18s. 9d.

Lead.—Trade demand has been heavier in this market, also, and a strong tone has ruled. The building trade, which is usually very quiet at this time of the year, has been stimulated to some extent by Government orders for A.R.P., etc.

Day-to-day quotations :—

Soft Foreign (Prompt).—Thursday, £15 17s. 6d.; Friday, £15 16s. 3d.; Monday, £16 2s. 6d.; Tuesday, £16; Wednesday, £16 1s. 3d.

Scrap.—Following the additional business brought about by the crisis, this market has again become quieter, and transactions have been fewer.

Approximate selling prices for old metal:—New aluminium cuttings, £67; rolled, £53; cast, £28; foil, £80. Copper, £38 to £42; braziery, £35. Brass (clean), £22 to £25. Zinc, £10. Lead, £15. Gunmetal, £39.

SALE BY PRIVATE TREATY

FOR SALE BY PRIVATE TREATY OWING TO EXPANSION OF OTHER SECTIONS.

HENRY BUTCHER & CO.

are instructed by an old-established and well-known Scottish Company, engaged for over 50 years in the manufacture of Rain Water Goods and Soil Pipes, to invite offers for the comprehensive and complete range of

PATTERNS AND PLANT

appertaining to the manufacture

of

RAIN WATER GOODS

and

SOIL PIPES AND CONNECTIONS,

together with the

GOODWILL OF THIS SECTION OF THE BUSINESS.

Particulars of :—

MESSRS. HENRY BUTCHER & CO., Valuers, Surveyors and Auctioneers, 63 and 64, Chancery Lane, London, W.C.2.

IN STOCK

TILGHMAN RECONDITIONED SHOT OR SAND BLAST PLANTS

Rooms, Barrels, & Chambers.

WE SHOT AND SAND BLAST FOR ALL TRADES

Established Fifty Years.

R. J. RICHARDSON & SONS, LTD.,

Commercial Street, Birmingham, 1.

Phone: MIDLAND 2281

Grams: "SANDBLAST, B'HAM"